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ANNOUNCEMENT—THE COMMERCIAL SIDE OF CENTRAL STATION DEVELOPMENT.

At the Denver convention of the National Electric Light Association there was evident a strong undercurrent of feeling on the part of those into whose hands were entrusted the interests of both large and small central stations throughout the country, that the time had come when a concentrated effort should be made along lines which would bring the companies into more direct communication with prospective patrons. It is a well-known fact that, taking advantage of the powerful lever of publicity, the older-line public service corporations have uprooted all manner of prejudice, and have made very rapid strides, not only in the larger cities, but in the small towns.

The ELECTRICAL REVIEW has ever been in the forefront in presenting to its readers the technical development of central station practice. As a matter of fact, it can point with pride to the very large share it had in bringing into existence the National Electric Light Association, having issued the editorial call on its own initiative that assembled the first convention in Chicago in February, 1885. But however great may be the development of central station practice along lines of refined engineering, there must be an outlet for the utility produced, in order that further progress can be made. It is urgently necessary that every means be adopted to educate the public up to the possibilities of a wholesale use of electric current. In some of the larger cities the astute management has made excellent use of legitimate methods of publicity to create a demand for current, which was quite necessary to improve the load-factor.

It is to the end that there may be an interchange of ideas concerning methods of securing new business and retaining old business against the encroachments of other forms of power and illumination, that the ELECTRICAL REVIEW will very shortly establish a Department under which will be classified the various methods by which companies throughout the country are making a bid for an increased sale of electrical energy.

Central station managers throughout the world are invited to contribute their ideas upon this subject. The increase in the demand for current in any locality is bound to stimulate that demand elsewhere. Whether this Department will be continued depends very largely upon the interest which is manifested by the central station companies. From the present indications, however, there is a demand for service of this nature, and we trust and believe that our efforts will be appreciated, and that they will receive the support of all the enterprising and progressive producers of electrical public service utilities.

WATER POWER AS A FACTOR IN INDUSTRIAL DEVELOPMENT.

In a paper read before a recent meeting of the Pacific Coast Engineering Congress, Mr. Charles H. Baker dwelt upon the advantages accruing to any locality from the possession of a water power, and predicted that, other things being equal, a city thus fortunately situated would forge ahead of others less fortunate.

Mr. Baker, in developing this idea, showed how the cost of power is a factor more or less important in all manufactured products, and that the cheapening of this item has been the great factor in the industrial progress of the world. M. Charvet, who has made a study of the subject, finds that a French laborer turning a crank, and receiving a pay of seventy cents per day, produces one horse-power-hour for eighty-five cents. Ranking next to the Frenchman is the ox turning a horizontal bar—a method still in use in eastern countries for grinding and crushing. This method produces one horse-power-hour at the much reduced price of twenty-three cents. Substituting a horse for the ox, the cost is reduced to something less than twenty cents. A steam engine, used in the inefficient way it is employed on

farms, produces a horse-power-hour for four cents. A gas engine is still cheaper. A windmill, when it works, gives one horse-power-hour for two cents; but a water power, when the cost of installation is not over $160 per horse-power, can produce a unit of work for one cent.

The advantages of a cheap source of power will be admitted by all, but desirable as this may be, it is not always the most important consideration. As Mr. Baker points out, the cost of manufactured articles involves the cost of power and the cost of the material, and these vary in relative importance according to the nature of the article produced. In some industries, notably the electrochemical industry, the cost of power is by far the most important item; hence such industries, to live, must locate near a source of cheap power. On the other hand, there are products in which the power item is of minor importance, and in which a third item, not mentioned by Mr. Baker—namely, the cost of transportation—may be even more important. These three factors, as well as the cost of labor, must be studied comparatively when seeking a location for a factory. It is a well-known fact that when the first large Niagara Falls power plant was planned, the builders anticipated a movement to that vicinity of a large number of manufacturing industries. In this they have not been disappointed, but the industries attracted there are not those at first expected. Niagara Falls has become a centre for large electrochemical establishments, in which the power cost is the most important item. There are other industries also using large amounts of power which have not gone there because, to them, it is more important to be nearer to the source of raw material, or, in some cases, to the market.

In California the high price of coal makes the water powers the more valuable, but this high price of coal is due, not to the cost of material nor of labor, but to the cost of transportation. Even in the cities of the East, where the coal mines are not more than a few hundred miles off, the cost of haulage is greater than that of the coal at the mines.

It is one of the triumphs of electrical engineering that it has made possible the utilization of our water powers, and has thus added to our resources a never-perishing source of power. Not until high-voltage transmission became practicable was it possible to use more than an insignificant fraction of our water powers. To-day cities fifty or one hundred miles away from waterfalls are depending largely upon them for their power. This is notably the case in California, Oregon and other western states, where San Francisco, Portland and Seattle see a bright future dawning, which has been made possible only by this great development. They are fortunate in having a cheap supply of power combined with the many other advantages of the electric motor. In other cities, less fortunately placed as regards cheap power, the advantages of the electric drive are no less realized, and in order that these may be obtained at not too great expense, large power plants are erected, which depend for their operation on coal mined at a distance and hauled to them. These cities, while possibly paying more for their power, enjoy advantages which the western cities have not; and until these are more than balanced by the increase in the cost of fuel, they need not be greatly alarmed. Of course, other things being equal, the city having the cheaper power will outstrip the others; but it is very seldom, if ever, that other things are equal.

INCONVENIENT POWER-PLANT LAYOUTS.

The final design of most modern power plants is the result of various compromises in which the object of the engineers is always operating efficiency as far as it can be assured without too high a first cost. The layout of equipment is often a very difficult problem on account of space limitations. It is important to remember that the operating convenience of the installation depends in large measure upon the relative location of the coal and ash pockets, the boiler, pump and engine rooms. There is not much advantage, for example, in providing numerous valves to increase the flexibility of the piping system unless the valves are for the most part placed in situations that the attendants can reach without ladders. In the large central stations the operation of remote valves by small motors of two or three horse-power is growing in favor, and the saving in time and labor is considerable. To close a large outboard exhaust valve with a thirty-inch spindle by hand means at least five minutes of hard muscular effort, to say nothing of the trouble of climbing to the height of the valve wheel; whereas with a small motor the work can readily be done in twenty-five seconds.

It is generally realized in large work that coal should be handled as little as possible between the bin and the furnace, and yet in many installations, in office buildings and other mercantile houses, great inconvenience is found in the fuel supply. A recent plant for office building service illustrates this. The boiler room is placed beyond the engine room in such a way that all the coal has to be hauled in hand-barrows past the latter over a run of some fifty feet; the machine room containing the electric elevator motors and automatic controlling switchboards is much nearer the boilers than it is to the generators; the engine room is located under the sidewalk gratings through which the dust of the street and the dirt from the coal supply wagons fall, and the ashes have to be hauled by hand from the boilers through the engine room before they can be removed on a hydraulic hoist to the street.

Such a design means increased depreciation from the fine dust which settles constantly upon the machinery; increased exertions on the part of the firemen and engineers to handle the fuel supply, keep the equipment clean and properly dispose of wastes, and greater cable-runs with extra first cost and higher power losses between the main switchboard and the elevator panels. If the boilers had been placed next the coal bin, and the engine room next the boiler and flanked by the elevator room, the convenience of operation would have been much improved over the present arrangement. The idea that attendance is a constant charge and that it makes little difference whether a man is wheeling ashes or sitting in the boiler room with his eye upon the steam gauge and water column is out of

harmony with the best views of to-day, which see in improved operating convenience the releasing of skilled labor for better inspection work and resulting broader economy of plant operation.

THE SPREAD OF THE MOTOR DRIVE.

Undoubtedly, one of the most important industrial developments of recent years has been the introduction of the electric motor into factory driving. This was accomplished only after a severe struggle on the part of those who believe that where there are a number of machines operated independently of one another the electric motor, on the whole, offers the cheapest and best means of driving them. Many obstacles were encountered that had to be overcome before the factory operators realized that there was truth in these assertions, for they at first compared the various systems of driving purely on a basis of the cost of power, not realizing that there were other factors involved equally, if not more, important than this one. But the truth of this is seen now, and the electric drive has become practically the standard for shop operation.

Before the acceptance of the motor for factory work had come about the electric motor had been adopted as the best driving mechanism in another field: that of city traction. This had been brought about only after numerous trials and many failures, the difficulties contended with being somewhat different from those met in introducing the motor into factories. In developing the electric railway the problem was one of devising a suitable system. It was necessary first to find an arrangement of parts that would be simple and yet reliable, and then to construct a motor which would not go to pieces under the conditions of exposure and neglect to which it would be subjected. The problem of introducing the motor drive into factories was, on the other hand, one of meeting the demands of the factory owner in such details as speed variations and uniformity of driving, as a reliable motor had already been produced.

Not content with the city traffic, the electric drive is extending itself further into the country, and is even trespassing upon the steam railway track. Not satisfied to be acknowledged as the standard for factory driving, the electric motor is edging its way further and further from the factory. It is becoming a valuable assistant of the workman in the small shop, and is finding a home in the fine residence. Wherever power is required, whether in small or large quantities, the electric motor asserts its advantages and claims at least a hearing, if not a trial. The dentist and the barber find it of valuable service. It drives the sewing machine at home, as well as pumping the water for the country house, chopping feed in the barn, and driving the churn. It runs the elevators in our office buildings, and drives the little fan which makes life bearable during the hot summer days. It ventilates the stuffy workroom and keeps the air in the restaurant fresh and sweet.

Having conquered a large part of the surface of the ground and the air above—at least, so high as our buildings and elevated roads reach—it has invaded the lower regions and is rapidly becoming the standard for mining work, where it not only hauls the coal or ore out, but drives the tools for loosening it from its bed. In this latter field it seems to be driving out compressed air, for in spite of the incidental advantage that the latter system has in that it discharges a certain amount of air at the point where work is being done, this, on the whole, is of little consideration; mines must be ventilated anyhow. The most important considerations affecting the tools are reliability and flexibility, and here the electric motor carries the day.

Wherever modern industry extends we find the electric motor working side by side with man. It is undoubtedly applied in more varied uses than any other power machine. In fact, it promises to become shortly the standard motive mechanism of the world, taking over to itself all branches of work, with but few exceptions. How few these will be no one can now say.

THE TELEPHONE QUESTION IN FRANCE.

The telephone situation in France has reached a serious stage. The telephone department has been unable to keep up with the increasing demands for service, and much of its present equipment is antiquated. The result is that the system is under a cloud, and telephone users are loud and vigorous in their complaints. They feel that they already pay an excessive rate, and in return get very unsatisfactory service. Not only are there not sufficient lines connecting Paris with important industrial centres, but it is difficult for one subscriber to get in communication with another anywhere. This being the state of affairs, telephone users in Paris have formed an association, with a view of pressing their claims for better service and demanding that they be given their dues.

The telephone department has had little means at its command for improving the situation, and it seems that it has not been sufficiently vigorous in pressing its claims before the French parliament. It has let matters drift along, and been satisfied with spreading the small funds given it as far and as thinly as it could. It is now demanded by the French telephone users that the telephone department lay the telephone situation plainly before parliament, and demand that it be given sufficient funds to put the system on its feet again. The sum required for this is not small, since not only must the system be greatly extended to meet the increasing demands, but a good part of the apparatus now used must be condemned.

The situation here is perhaps typical of what must be expected when a public service of this kind is operated by the government. The difficulty of obtaining sufficient money to keep the system in the most approved condition is not small, and when to this is added the necessity of proving to a captious assembly, the various parts of which have irons in the fire, that the apparatus now in use is not satisfactory and must be thrown away, the situation becomes even more difficult. Legislatures are apt to be careless in small money matters, and then try to save the situation by denying large funds where they are most needed. The public utilities publicly operated are notorious for the poor service given. We need more light on the experience of other countries in this matter, as in general it is cheaper to learn by the experience of others. But many of us will not believe a fire is hot until we are burned.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER III.

NATURE OF THE CORPUSCLE—THE ELECTRICAL THEORY OF MATTER.

The conception of the corpuscle as originally advanced is that it is a small piece of matter having a mass about 1/770 of that of the hydrogen atom, and carrying a unit negative charge of electricity, which is exactly the same as that carried by any univalent anion, such as the chlorine ion in solution. The corpuscle is thus both material and electrical in its nature.

We shall now take up Thomson's study of the corpuscle itself, and see how the original conception has been modified and the reasons for the view that we hold at present.

Let us first ask what reason have we for supposing that the corpuscle contains any matter at all? How do we know that it is anything but electrical energy? The answer would be that the corpuscle has both mass and inertia, and therefore must contain matter, since matter only has these properties. We shall now see whether this line of reasoning is valid.

In a paper published more than twenty years ago, J. J. Thomson at least raised the question as to whether inertia itself is not of electrical origin, and Townsend showed that the charge on a moving sphere must have inertia, since it would produce an electromagnetic field of force in moving through the ether. The mass of such a charged sphere would, then, be greater than that of the same sphere when uncharged.

Thomson showed that the particle must move very rapidly in order to have appreciable changes in its mass. Indeed, it must move with a velocity that is comparable with that of light, in order to produce measurable changes in its mass.

While the ordinary cathode rays move with a velocity which is only about 3×10^9 centimetres per second, the particles shot off from radium have a velocity as high as 2.8×10^{10}, which is nearly that of light itself $= 3\times10^{10}$. If the velocity with which the charge moves has any effect on its mass, we would expect that the mass of these rapidly moving particles would be greater than that of the same particles when moving less rapidly. This question has been answered by the experiments of Kaufmann. He determined the value of $\frac{e}{m}$ for these more rapidly moving particles, by means of the method already described, using the magnetic and electrical deflections. He found values as low as 0.63×10^7 for the most rapidly moving particles. Since e is constant, the charge being the same independent of the velocity, it follows that the mass of the rapidly moving charged particle is greater than that of the more slowly moving charged particle in the cathode ray.

Kaufmann's experiments went farther. By means of the electric and magnetic deflections, he determined the values of $\frac{e}{m}$ for the different particles shot off from radium with different velocities. He obtained the following results: The velocities v are divided by 10^{10}, and the values of $\frac{e}{m}$ by 10^7, for convenience. The following figures give us the relative values, which are all that we desire at present:

v	$\frac{e}{m}$
2.36	1.31
2.48	1.17
2.59	0.975
2.72	0.77
2.83	0.63

It is obvious from the above data that as the velocity of the charged particle increases, the value of $\frac{e}{m}$ decreases. Since the value of the charge, e, remains constant, independent of the velocity, it follows that the mass m, becomes greater and greater as the velocity of the charged particle becomes greater.

The experiments of Kaufmann show conclusively that the mass of a charged particle changes with the velocity of the particle, increasing as the velocity increases. In a word, a *part of the mass of the particle, at least, is of electrical origin.*

This would naturally raise the question, what part of the mass is electrical? Is it possible that all mass is electrical? Thomson has thrown light on this question in the following manner. When the corpuscle moves slowly the mass, as we have seen, does not depend on the velocity, and does not, therefore, change with the velocity. When, on the other hand, the velocity of the corpuscle approaches the velocity of light, the mass varies with the velocity, as is shown by the results of Kaufmann. On the assumption that the whole mass of the corpuscle is electrical, Thomson has calculated the ratios of the masses of the particles, moving with high velocities, but with different velocities as in the experiments of Kaufmann, to the constant mass of a slowly moving particle; and compared the results with those found experimentally by Kaufmann. The following table shows the result of the comparison. In column I are the velocities in centimetres per second; column II are the calculated ratios, and column III the experimental values of Kaufmann:

I Velocities.	II Calculated Ratios.	III Experimental Values.
2.36×10^{10}	1.65	1.5
2.48×10^{10}	1.83	1.66
2.59×10^{10}	2.04	2.0
2.72×10^{10}	2.43	2.42
2.85×10^{10}	3.09	3.10

The agreement between the calculated and observed values is surprisingly good. This is a strong argument in favor of the correctness of the assumption on which the calculation is based, *viz., that the whole mass of the corpuscle is electrical.*

If the whole mass of the corpuscle is electrical, why assume that the corpuscle contains any so-called matter at all? All of the properties of the corpuscle, including the two properties that we have been accustomed to associate with matter, inertia and mass, are accounted for by the electrical charge of the corpuscle. Since we know things only by their properties, and since all of the properties of the corpuscle are accounted for by the electrical charge contained in it, why assume that the corpuscle contains anything but the electrical charge? It is obvious that there is no reason for doing so.

The corpuscle is, then, nothing but a disembodied electrical charge, containing nothing material, as we have been accustomed to use that term. It is electrical energy, and nothing but electrical energy. With this new conception a new term was introduced, and, now, instead of speaking of the corpuscle we speak of the *electron. The electron is, then, a disembodied electrical charge, containing no matter, and is the term which we shall hereafter use for this ultimate unit, of which we shall learn that all so-called matter is probably composed.*

If the electron contains nothing that corresponds to our ordinary conception of matter, and since the same electron can be split off from the atoms or molecules of all substances, the question naturally arises, is not all so-called matter made up of these electrical charges or electrons? Is not all matter of an electrical nature? There is a large amount of evidence, part of which has already been furnished, which answers this question in the affirmative. Indeed, this conclusion is accepted,

at least tentatively, by a large number of the leading Physicists and Physical Chemists the world over.

THE ELECTRON THE ULTIMATE UNIT OF MATTER.

According to the above theory the electron is the ultimate unit of all matter. The atoms are made up of electrons, or disembodied electrical charges, in rapid motion; *the atom of one elementary substance differing from the atom of another elementary substance only in the number and arrangement of electrons contained in it.* Thus we have at last the ultimate unit of matter, of which all forms of matter are composed, and the remarkable feature is, that this ultimate unit of which all matter is composed is not matter at all, as we ordinarily understand that term, but energy,—electrical energy.

This recalls a paper published a number of years ago by Ostwald, on "The Overthrow of Scientific Materialism" (Die Ueberwindung des Wissenschaftlichen Materialismus"), which made an impression at the time that it appeared, or rather a number of impressions. The arguments and conclusions in this paper were accepted by some without question, and were severely criticised by others, especially by the mathematical physicists of Germany. Whatever our opinion of the paper as a whole, there is one point at least, brought out so clearly, that there can scarcely be any question about it, and that is, that matter is a pure hypothesis.

What we know in the universe, and all that we know, is changes in energy. In order to have something to which we can mentally attach the energy, we have created, in our imagination, matter.

Matter, then, is a pure hypothesis, and energy is the only reality. We are accustomed to take exactly the opposite view, and regard matter as the reality, and energy as hypothetical. If Ostwald accomplished nothing else by the paper in question than the mere calling attention to the hypothetical nature of matter, he made an important contribution to science.

It should also be noted that for a long time Ostwald has insisted not only that matter is a pure hypothesis, but there is not the least evidence for its existence, as we ordinarily understand the term. It is interesting to note that Thomson has reached the same conclusion, as the result of one of the most brilliant series of experiments that have ever been carried out in any branch of experimental science. We thus have a direct experimental verification of a conclusion, the importance of which it is difficult to overestimate.

EARLIER ATTEMPTS TO UNIFY MATTER.

Perhaps the most important bearing of the electron is that it furnishes us with the ultimate basis of all matter. The importance of securing such an ultimate unit is shown by the number of attempts that have been made in this direction. One of the first noteworthy efforts we owe to the chemist Prout. After fairly accurate determinations of the atomic weights of a number of the more common elements had been made, it appeared that when these values were expressed in terms of the atomic weight of hydrogen as unity, they were all nearly whole numbers. Indeed, the deviations at first discovered were hardly greater than the experimental errors.

This led Prout, as early as 1815, to propose the theory that hydrogen is the ultimate element, of which all other elementary substances are made. The atoms of all other elements are simply condensations of hydrogen atoms, the number of hydrogen atoms contained in an atom of any element being expressed by the atomic weight of the element in terms of hydrogen as unity.

This hypothesis of Prout accounted for all the facts that were known at the time when it was proposed, and it is a praiseworthy attempt to solve the problem of the relation between the various chemical elements.

As experimental methods became more refined, and atomic weights more accurately determined, it gradually became obvious that the atomic weights of even some of the more common elements are not whole numbers in terms of hydrogen as one, but differ very appreciably from whole numbers. Indeed, the atomic weights of some elements fall almost halfway between whole numbers. This was, of course, a deviation too large to be accounted for on the basis of experimental error, and was, therefore, the death blow to the hypothesis of Prout as it was originally proposed by its author.

Subsequent suggestions by Marignac and others to make the half-atom of hydrogen, or even the quarter-atom, the basis of all matter, did not increase scientific respect for the hypothesis of Prout. Having once begun to divide the hydrogen atom the process could be continued indefinitely, and thus the theory could be, and was for a time, brought into disrepute.

It must not, however, be forgotten that if to-day we take those chemical elements whose atomic weights are most accurately determined, and calculate the atomic weights on the basis of oxygen $=16$, which is the system now in general use, we will find that a very large proportion of the atomic weights are so close to whole numbers that the deviations can be accounted for on the basis of probable experimental errors.

Such an examination was recently made by the Hon. R. J. Strutt, who pointed out that the number of elements whose atomic weights are whole numbers is many times too large to be accounted for on the basis of chance.

Taking all of the facts into account, we recognize, of course, that the hypothesis of Prout, either as originally proposed, or as subsequently modified, is not rigidly true; but we still feel intuitively that there is something in it. The coincidences are far too numerous to be attributed to mere chance.

OTHER RELATIONS BETWEEN THE ELEMENTS.

A number of other attempts have been made to point out relations between the atoms of the different chemical elements, with the hope of finding something in common between them. Döbereiner early noticed that of three closely related chemical elements, the atomic weight of the second heaviest element is almost exactly the mean of the atomic weights of the lightest and heaviest elements of the group of three. A few examples will make this clear. Take the three elements, calcium, strontium and barium. The atomic weight of calcium is 40.1; the atomic weight of barium is 137.4. The mean of these two values is 88.7, and the atomic weight of strontium is 87.6. To take an example from the negative elements, the above being taken from the positive, let us choose sulphur, selenium and tellurium. The atomic weight of sulphur is 32.1; that of tellurium 127.0. The mean of these two values is 79.6, while the atomic weight of selenium is 79.2.

Relations such as these are, of course, purely empirical, and their meaning is entirely unknown, yet they are, to say the least, suggestive.

We now come to the great generalization of Newlands, Mendeléeff and Lothar Meyer, known as the Periodic System. This is the only attempt thus far made to coordinate all of the chemical elements into one comprehensive system. The system is too well known to be discussed at any length in the present connection. It

is referred to here to call attention to the most serious effort that has ever been made to discover general relations holding for all of the chemical elements.

It is well known that in the Periodic System the chemical elements are arranged in the order of their increasing atomic weights. It is not only found that the chemical and physical properties of the elements are a function of their atomic weights, but a periodic function of the atomic weights. If we arrange the elements according to the above principle, in groups of seven, allowing the eighth element to fall under the first, it is well known that the elements with chemically allied properties will fall in the same vertical columns.

It would lead us too far in this connection to point out the many and interesting chemical relations brought out by the Periodic System, and, perhaps, what is even more important, the relations between the atomic weights of the elements and their physical properties. It is sufficient to note here that such relations do exist, and that these are of a general character, embracing practically all of the elements known to the chemist.

The writer is in no sympathy with the attempt that is being made in certain directions to belittle and cast into the background the Periodic System. Of course, every one must recognize that the system is incomplete. Indeed, it is not only far from being complete, but leads in places to inconsistencies. Yet the Periodic System is a great generalization, which coordinates an enormous number of otherwise disconnected facts, and has done more towards placing inorganic chemistry upon a scientific basis than all the other generalizations together, that were proposed up to 1885. Indeed, it was the philosophy of inorganic chemistry for a comparatively long period, and has far from lost its usefulness at present. As we shall see, it again comes to the front in connection with the electron theory of matter that we are now discussing.

These are some of the more important of the earlier attempts to discover connections and relations between the different chemical elements. None of these, with the exception of the hypothesis of Prout, can be said to have attempted to solve the problem of the nature of the chemical elements, even as referred to some one known element as the standard.

In the above very brief review of the efforts that have been made to establish connections between the various chemical elements, a number of pure speculations by the ancients have been omitted. Most of these are only of historical interest and, since they do not admit of experimental test, are of little or no scientific importance.

We shall turn now to the electron theory of matter, and study some of its applications.

CONVENTIONS OF STREET RAILWAY ASSOCIATIONS.

STREET RAILWAY WEEK AT PHILADELPHIA, PA., BEGINNING SEPTEMBER 25.

The annual meeting of the American Street Railway Association will be held at Philadelphia, Pa., on Wednesday and Thursday, September 27 and 28. An important part of the proceedings of this convention will be the consideration of the questions relating to a more complete and perfect organization. The American Street Railway Association and the various associations affiliated with it in street and interurban railway work will undertake to ratify an amended constitution and by-laws which will govern the parent organization and the organizations tributary to it. In pursuance of a resolution passed at the last annual meeting of the American Street Railway Association, held at St. Louis, Mo., a joint committee of the various organizations has been hard at work preparing a new plan of organization.

The American Railway, Mechanical and Electrical Association will hold its convention in Philadelphia, September 25 and 26. The following programme has been announced.

MONDAY MORNING, SEPTEMBER 25.

Eight forty-five o'clock, registration of delegates, South Building, Philadelphia Museum. Ten o'clock, address of welcome by Mayor John Weaver. Address by the Hon. W. Caryl Ely, president of the American Street Railway Association. Annual address by the president. Report of executive committee. Report of secretary and treasurer.

MONDAY AFTERNOON, SEPTEMBER 25.

The following papers will be read and discussed: "Power Distribution," C. H. Hile, Boston; "The Power-Station Load-Factor as a Factor in the Cost of Operation," L. P. Crecelius, St. Louis; "Report of the Committee on Controlling Apparatus," J. S. Doyle, New York city, chairman.

TUESDAY MORNING, SEPTEMBER 26.

"Report of the Committee on Way Matters," F. G. Simmons, Milwaukee, chairman; "Report of the Committee on Maintenance and Inspection of Electrical Equipment," William Pestell, New York city, chairman; a paper entitled "The Power-House," by Fred N. Bushnell, Providence, R. I.

TUESDAY AFTERNOON, SEPTEMBER 26.

Paper, "The Track Brake," F. F. Bodler, San Francisco; discussion of question box; reports of special committees; election of officers.

The ninth annual convention of the Street Railway Accountants' Association of America will be held on September 28, 29 and 30. The annual address of the president will be delivered on Thursday, September 28, at 2 P. M. Following this will come the report of the executive committee, the report of the secretary-treasurer, the appointment of committees on nominations and on resolutions, and the report on the proposed reorganization of the American Street Railway Association.

On Friday, September 29, at the morning session, reports will be heard from the various standing committees.

On Friday, at 2 P. M., the following papers will be read: "The Cost of Carrying a Passenger," C. S. Tingley, Philadelphia; "Interurban Fare Collections," Irwin Fullerton, Detroit; "Interurban Ticket Accounting," J. H. Pardee, Canandaigua, N. Y.; "Accounting with Four Departments," H. M. Beardsley, Elmira, N. Y.

On Saturday, September 30, at the morning session, unfinished business will be taken up, the reports of the resolutions committee and the committee on nominations will be received, to be followed by the election and installation of officers.

The Colorado Electric Light, Power and Railway Association.

The third annual convention of the Colorado Electric Light, Power and Railway Association was held at Glenwood Springs, Col., September 18, 19 and 20. The following programme was announced:

1. Roll call and presentation of candidates.
2. Reading of the minutes of the last meeting, unless passed by the unanimous consent of the association.
3. Address by the president.
4. Reading of papers and discussion.
5. General business.
6. Report of the executive committee.
7. Report of the secretary and treasurer.
8. Report of the finance committee.
9. Report of the membership committee.
10. Report of the advisory committee.
11. Report of special committees.
12. The election of officers and the executive, finance, membership and advisory committees.

The following papers were presented: "Notes on an Up-to-Date Substation," A. M. Ballou; "A New High-Candle-Power Incandescent Lamp," C. B. Mahaffey; "The Application of Electric Power to Gold Dredging," J. F. Dostal; "Isolated Plants," H. L. Wolfenden; "Getting New Business," R. L. Goodale; "The Mercury Arc Rectifier," G. N. Robinson; question box.

ON THE COST OF IRRIGATION BY ELECTRICALLY DRIVEN PUMPS FROM TRANSMISSION SERVICES.[1]

BY W. W. WHEELER.

When a transmission system arrives at that inevitable stage of development wherein it reaches into outlying farming communities for the purpose of building up a pumping load as well as of developing the productiveness of the country that is to be tributary to its lines, the question that is most frequently asked is: "What will it cost to irrigate an acre of land with water pumped by electrical power?"

To answer this question with any close degree of accuracy requires an intimate knowledge of the conditions which prevail regarding several factors—namely, the cost of power, the character of the lands to be irrigated, and the depth from which the water must be raised. My own experience is mainly confined to the territory covered by the transmission circuits of the Northern California Power Company, operating in that portion of the northern part of the Sacramento valley contained in portions of Shasta, Tehama and Glenn counties in Northern California, an experience which this paper reflects.

In the popular mind irrigation implies a gravity or surface catchment for delivering water to the land, but in recent years pumping has become more and more recognized by engineers as the most economical means for supplying water for all irrigating purposes, and it is destined to grow in importance as the cost of power becomes less through the development of transmission enterprises. Lands that lie beyond the economic reach of gravity supplies of water are often entirely reclaimable by pumping, and numerous cases exist where both systems are available for use, but in practically every case the advantage as to cost and operating expense is found to be on the side of the pumping plant. The vagaries of the wind make the windmills unreliable, gasoline engines though very efficient as to fuel consumption require great care and are expensive to install, steam power is not to be considered except in large units because of the heavy first cost and the expense of operation and attendance, but with electric power rests every advantage in cheapness of installation and operation. These plants require practically no attendance and the power is reliable.

[1] Paper read before the electrical transmission section of the Pacific Coast Engineering Congress, Portland, Ore., June 29-30, 1905.

Of the many types of pumps available and in use for irrigation the most common perhaps is the centrifugal pump, which is made on the Pacific coast in standard sizes ranging from two inches to fifteen inches in suction and discharge pipe diameters, and on special order can be made in any size required. The first cost for a complete electric motor and centrifugal pumping plant will depend on the size of the plant and the type of motor used. For small plants capable of irrigating one hundred acres or less, the first cost will usually range from twelve dollars to fifteen dollars per irrigated acre, while the cost of operation will be found to vary from two dollars and seventy-five cents to three dollars and seventy-five cents per irrigated acre.

In this connection it will be of interest to refer to an estimate recently made by the United States Geological Survey for an extensive pumping system designed to irrigate some 300,000 acres of land in the San Joaquin valley, of California. This estimate indicated the first cost of the plant to be about four dollars per acre, and the annual cost of operation and maintenance to be fifty cents per acre-foot, or approximately one dollar per year per acre irrigated. When it is borne in mind that the average cost of installation of gravity supply systems in California has been about thirteen dollars per acre, and that the annual charge for irrigation averages one dollar and sixty cents per acre, the great possibilities of pumping can be appreciated.

The circuits of the Northern California Power Company extend down the Sacramento valley from Redding as far as Vina in Tehama County on the east side of the Sacramento river, and Willows, Glenn County, on the west side, and as a general statement it may be said that within this great district land can be irrigated for one hundred days, which covers the period of the year during which irrigation is necessary, at a cost of two dollars and fifty-four cents per acre. In this the water which will be distributed is equivalent to a twenty-four-inch rainfall. This estimate is based on water being lifted from a depth of thirty feet to irrigate a tract of one hundred acres of land, and the expenditure necessary for so doing would amount to fifteen dollars an acre for the installation of a centrifugal pump direct-driven by a fifteen-horse-power induction motor. The cost for power for this period of one hundred days in the territory defined, is at the rate of thirty-five dollars per horse-power-year, and the cost for maintenance is practically nothing. In fairness, however, due cognizance must be taken for the interest on the money invested and as the cost per acre for a pumping plant to irrigate a one-hundred-acre tract is fifteen dollars, the interest on this investment for one year at six per cent is ninety cents. This amount should be added to the two dollars and fifty-four cents paid for power, making the total cost per acre for the irrigation necessary during one year to be three dollars and forty-four cents. If to this be added the very liberal estimate of six cents per acre for incidentals, the total cost will not be far from three dollars and fifty cents per acre per year.

Some specific instances will prove convincing: at Redding there is a pumping plant consisting of a fifty-horse-power type C Westinghouse induction motor, belted to an eight-inch horizontal centrifugal Jackson pump that delivers eighty miners' inches of water under a pressure of twenty-four pounds per square inch, and with a suction lift of fifteen feet, through 4,500 feet of eight-inch riveted pipe. This plant supplies water for gardens, orchards and alfalfa lands, and the water is sold at the rate of ten cents per inch per twenty-four-hours' service.

About one mile south of Redding a seven and one-half-horse-power type C induction motor, belt drives a four-inch Jackson centrifugal pump of the vertical tower type, which lifts 275 gallons of water a minute to a height of twenty-seven feet for the irrigation of twenty-five acres of alfalfa. This plant was installed about three years ago and the owner is authority for the statement that during the first year of its operation the increased productiveness of the land, because of irrigation, enabled him to clear enough therefrom to pay for one-half of the first cost of the plant in addition to his yearly power bill amounting to $175.

About a mile further down the Sacramento river a somewhat similar plant is being installed. This plant consists of a ten-horse-power type C motor belted to a No. 5 Gould centrifugal pump which will lift water to a height of thirty-two feet for the irrigation of fifteen acres of alfalfa and six acres of garden land.

At Anderson the Bellevue Irrigation Company is operating a fifty-horse-power type C induction motor, which is direct-connected to a ten-inch Krough "Patented California pump" having a double eight-inch suction and a ten-inch discharge opening. This equipment, which is securely anchored to bed-rock, is placed

over the water on a platform that is eight feet above the low-water mark. The two suction pipes project about three feet below the surface of low water and are surrounded by floating wooden platforms, the purpose of which is to prevent the formation of whirlpools and the sucking of air into the pump. The discharge pipe, which is eighteen inches in diameter and fifty-four feet long, is made of No. 16 steel with flanged joints bolted together and connected to the pump by means of a taper joint. This plant shows an efficiency of seventy-two per cent and discharges 489.8 cubic feet of water per minute into a large wooden box located at the head of the ditch leading to the reservoir. This ditch is 1,800 feet in length, and for a distance of 600 feet it is built up eight feet above the ground. Its grade is one-eighth of an inch to the rod, and measures seven feet across the top, four feet across the bottom, with a depth of three and one-half feet. The reservoir, which is nearly circular in form with a diameter of 200 feet, was formed by scraping up dirt and throwing it up into a levee, and when filled holds approximately 160,000 cubic feet of water. The main canal leading from the reservoir is 7,850 feet long, ten feet wide and four feet deep, and at its lower end there are three measuring boxes each feeding lateral ditches for distributing water over some 400 acres of prune orchard and 100 acres of alfalfa. Water from this system is sold at the rate of ten cents per miners' inch, under a four-inch pressure per twenty hours. It may be added that in or about Anderson there are several small pumping plants, ranging in capacity from one-half to two horse-power.

At Cottonwood there are also several small plants of the sizes last indicated, together with a number of others, one of which consists of a five-horse-power Wagner single-phase motor belted to a three-inch vertical centrifugal pump of Krough manufacture, which lifts 215 gallons of water per minute to a total height of twenty-six feet through a six-inch casing pipe about forty feet long. This pump irrigates twenty-six acres of alfalfa, and last year the total cost of power for its operation was $65.40.

At Red Bluff a thirty-horse-power type C induction motor operates by belt connection an ancient type of five-inch Jackson centrifugal pump which is used for the irrigation of 135 acres of orchard lands. The plant raises 315 gallons of water forty-eight feet high through 900 feet of ten-inch pipe, and last year the cost of power for its operation was $314.11.

Several pumping plants are to be found at Red Bluff, but perhaps the most interesting consists of a seven and one-half-horse-power Wagner single-phase motor which is belted to a No. 2½ Fulton power head for the operation of a cylinder five by eighty inches in size. This cylinder is placed eighty-nine feet from the top of the well which was bored by the county of Tehama for experimental purposes with the idea of ascertaining if it were possible to obtain artesian water. Originally the well was drilled to a depth of 1,375 feet, but as a natural flow of water was not obtained at that depth, it was decided to open out the well with dynamite. Owing to an accident, however, the charge went off prematurely in the neighborhood of 500 feet from the top, with the result that its depth is now only 475 feet, but it gives an unlimited supply of water. It is a ten-inch bored well with steel casing.

Three miles below Red Bluff on the Sacramento river there is a twenty-horse-power induction motor which drives by direct-connection a Krough centrifugal pump that lifts 1,600 gallons of water per minute to a height of twenty-six feet with a total or over all efficiency of sixty-nine per cent. This plant irrigates eighty acres of alfalfa; it runs approximately eight days during each five weeks, and the land it irrigates raises annually seven crops of alfalfa at a cost of $185 per year for power.

At Tehama there are several small plants most of which are for domestic and household uses, but one of them is worthy of special note in that it consists of a three-horse-power Wagner single-phase motor driving by direct-connection a Gould triplex plunger pump which supplies the town with water.

At Corning there are in particular two ten-horse-power plants each of which furnishes water for the irrigation of orange groves, each motor being of the induction type and connected to its respective pump by belting. In the first installation a tower type Byron Jackson two and one-half-inch pump lifts water a total of 135 feet through two lines of three-inch redwood pipe, each 1,100 feet long, whence the water is delivered to a reservoir from which it flows by gravity over a forty-acre orange tract. The cost of power for the operation of this plant last year was $225. In the second plant a three-inch centrifugal pump of the horizontal shaft type lifts water to a height of sixty-five feet through 350 feet of five-inch standard screw-iron pipe into a concrete reservoir forty feet long, thirty feet wide and twelve feet deep, whence it is drawn through ditches for the irrigation of thirty acres of orange land. In this plant last year the cost of power was $223.15.

At Corning and Orland there are some twenty-odd electric pumping plants which range in capacity from one-half horse-power up to seven and one-half horse-power and are used for various purposes, such as watering stock, irrigating orchards, berry patches, vegetable gardens, lawns, and for general household purposes.

Why electrically driven pumps are not more generally used in irrigation when the service is rendered at such comparatively light cost of installation and operation, is beyond comprehension, particularly when the great increase in productiveness which results therefrom is taken into consideration. It has been suggested that a favorable field for a business enterprise exists in encouraging irrigation by means of electric power through the organization of a company that will install electric pumping plants to be paid for under easy terms out of the guaranteed increased production of the land. That such an enterprise would be profitable is not to be doubted, for while there is so much rain in the upper Sacramento valley, for instance, that farmers and orchardists can raise fair crops without irrigation, this very fact has deterred them from investigating the big profits to be made by irrigating their orchards and fields. Even if they do understand the great benefits to be derived from irrigation, they seem to rest content in the belief that some day some million-dollar company or the government will undertake the great enterprise of building a canal to convey water from the river to their bench lands. This day dream will not be realized for years, and in the meantime their profits are by no means those which would accrue were modern engineering methods impressed in their service. By irrigating by electrical power each small land holder can own an independent irrigation system the cost of which may be accurately determined before its installation, and similarly its profits can be closely predetermined. There is no hazard.

Beginning on September 1, the subscribers of the National Telephone Company, London, England, are to use the Anglo-French and Anglo-Belgian telephone service under the same conditions as post-office subscribers. The service is at present limited to the London exchanges and the chief exchanges in each provincial town where post-office subscribers are now admitted to the through service.

The Street Railway System of the Borinage.

By Dr. Alfred Gradenwitz.

AFTER the first single-phase railway, the Stubaital railway, had been taken into operation on August 1, 1904, a similar railway system has been inaugurated on April 6 last, in the Belgian colliery district, west of Mons, called the Borinage. This street railway system is owned by the Société Nationale des Chemins de Fer Vicinaux which operates upward of 2,200 kilometres of street railway. The system in question consists at present of the following lines:

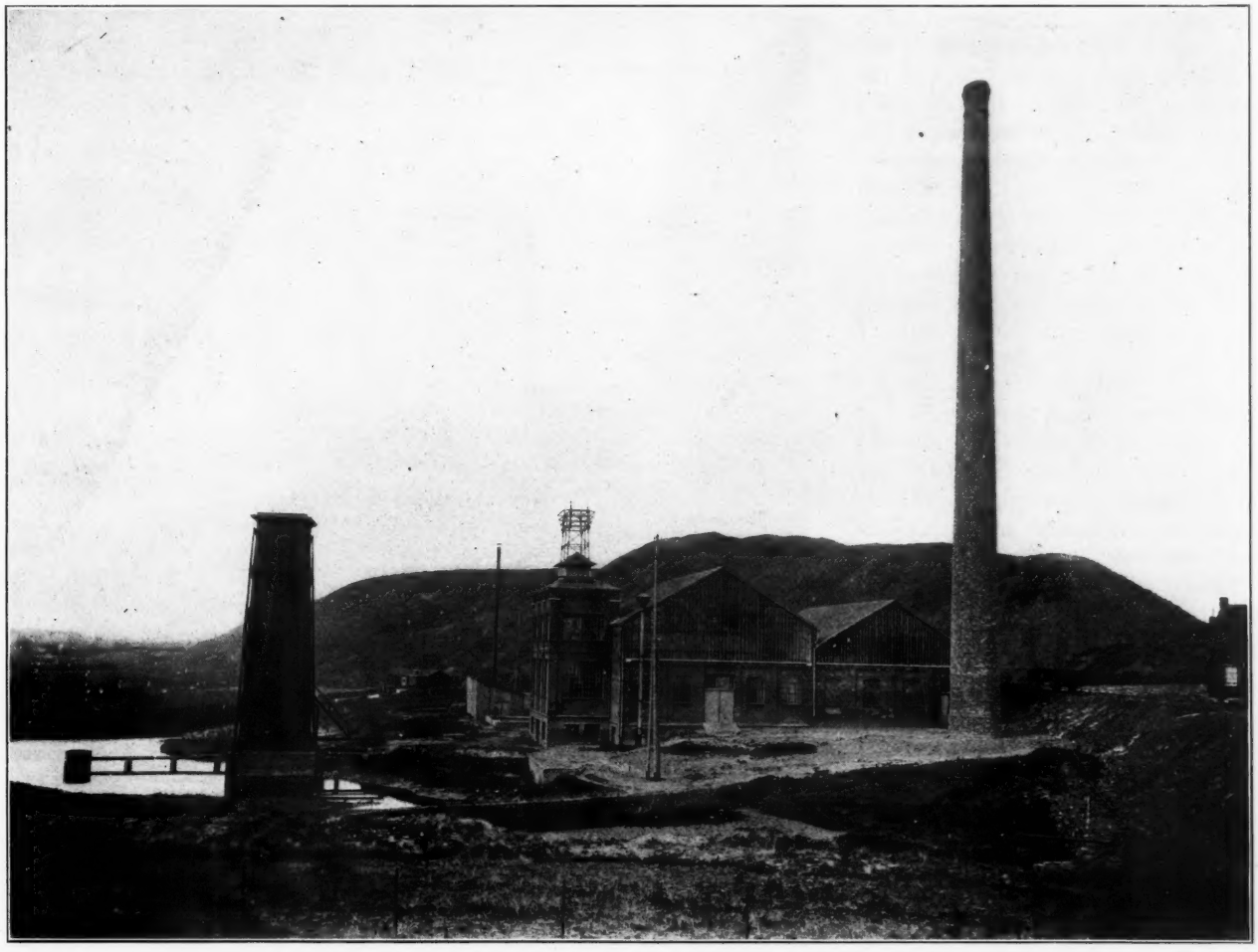
St. Chislain, Frameries, 11.91 kilometres; St. Chislain, Eugies, 7.80 kilometres; Quaregnon, Eugies, 8.06 kilometres; Quaregnon, Frameries, 9.20 kilometres; Pâturages, Wasmes, 0.85 kilometre.

In addition to the above, extensions such as to bring the aggregate length to 129 kilometres have been provided for. After the system will have been completed entirely, it is to be supplied with alternating current at 6,600 volts from a single point. In the actual state of operation the pressure is reduced from 6,600 volts to the trolley-wire tension (600 volts) by means of track transformers. After the extensions above referred to have been completed a higher pressure is to be used in connection with the trolley wires so as to dispense with the track transformers.

All the different lines of the Borinage system traverse mostly roads leading through inhabited districts, while special tracks have been provided at some places. The ground is somewhat hilly, the maximum grade being 7.1 per cent. Most of the lines are single-track lines with switches, while the latter have been extended at some places so as to have some short double-track lines.

On workdays a sixty-minute service is to be installed on the first four lines enumerated above, while a thirty-minute service will be organized on the fifth line. The schedule speed is 10.5 kilometres per hour, while the maximum speed on the free track is thirty kilometres. The current feeding the line is derived from a power station erected by the Allgemeine Elektricitäts Gesellschaft, between La Bouverie and Wasmes. This power station moreover supplies power and light to the whole surrounding district, which greatly reduces the cost of the current.

Herewith is shown an exterior view of the power station consisting of a boiler house and engine room, the latter having an extension where the switchboard is located. The boiler house contains three double fire-tube boilers of ninety square millimetres heating surface, which have been supplied by Jacques Piedboeuf, of Jupille, near Liege. On top of each boiler there is a superheater of eighty-five square metres heating surface, constructed by the Aschersleben Maschinenfabrik A. G. After leaving the fire tubes, the fire gases



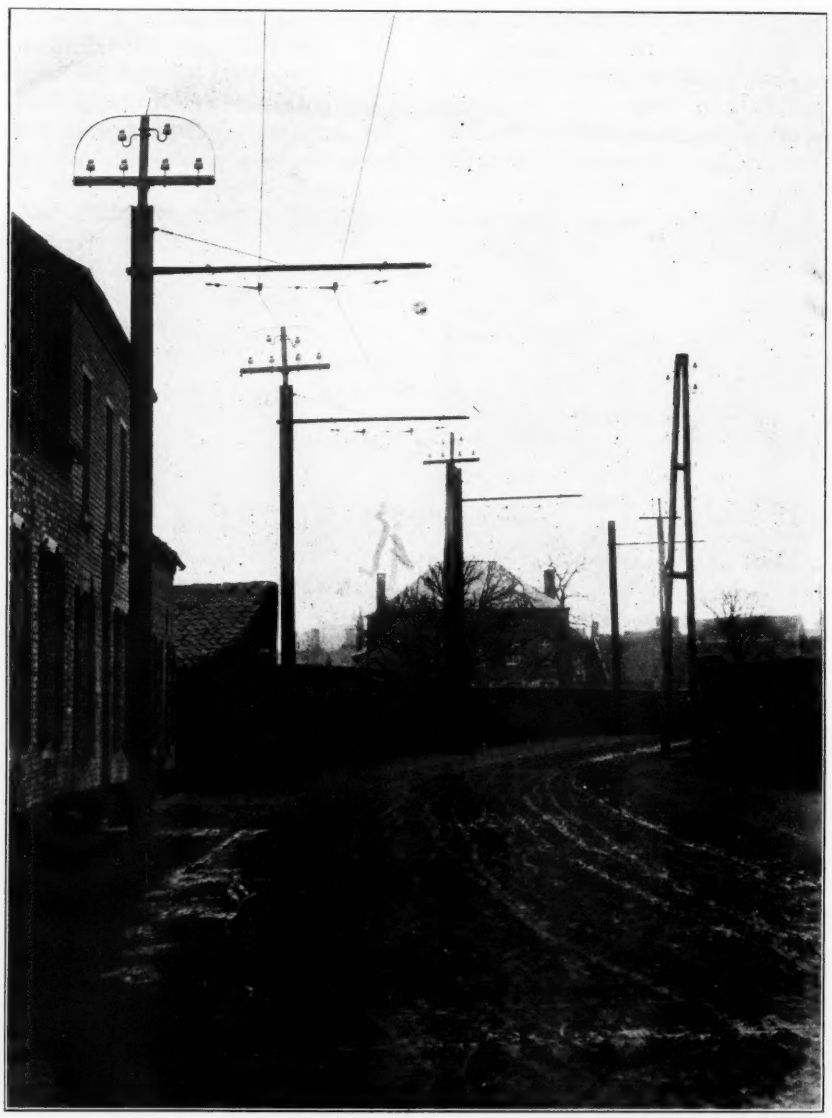
Power Station, Single-Phase Railway System of the Borinage.

traverse the superheater whence they enter the lateral slides. Chamotte slides enable the amount of superheat to be controlled, while the tubes and valves have been so arranged as to allow of operation both with and without superheater. The escaping gases further traverse an economizer of 128 tubes, where the water to be fed is preheated to a temperature of 100 degrees centigrade. Two steam pumps of twelve cubic metres hourly output each serve as feed pumps.

The engine room includes three sets, consisting of horizontal compound tandem engines of the Société Anonyme des Anciens Ateliers de Construction Van den Kerchove, of Ghent, and which have valves of the piston type. Two of the sets have a normal output of 400 electrical horse-power and a maximum capacity of 610 horse-power during one-half hour at 120 revolutions per minute. One set has a normal capacity of 220 horse-power and a maximum capacity of 350 horse-power during one-half hour at 133 revolutions per minute. The steam pressure is nine atmospheres in the high-pressure cylinder, the superheat being 350 degrees centigrade. Each engine has been provided with a jet condenser. On the shaft of each steam engine has been mounted a three-phase generator, the exciter dynamos being connected direct to the free end of each shaft. The generators are star-connected. The two larger forty-pole units are designed so as to supply 375 kilovolt-amperes as single-phase alternating current when using any two phases of the star, or 357 kilovolt-amperes as three-phase currents at forty periods. The smaller generator is a thirty-six-pole machine and is able to supply 225 kilovolt-amperes single-phase or three-phase; all the machines generate 6,600 volts; they are provided with a rotating magnet wheel and stationary armature. Tirrill regulators have been provided to allow of automatic voltage regulation.

As the power station is intended to supply both three-phase and single-phase alternate currents, the switching plant has been composed of three parts, *viz.*, the dynamo panels located in the centre and which at the same time carry the apparatus of the exciter machines, the lighting panels placed at the right and the traction panels placed at the left. The machines can be switched onto two rows of bus-bars, one of which is connected to the bus-bars of the lighting system, while the other communicates with the traction bus-bars. At some hours of the day there is, at the same time, only a slight demand both for lighting and traction current when the whole of the current is supplied by a single machine, the two rows of bus-bars being connected together by a special oil-switch. For the same reason the traction bus-bars have been made to include three bus-bars, only two of which have extensions toward the traction panels. Only two phases are used on each three-phase dynamo for traction purposes, though any two of the three phases can be used to supply the traction current. It has been demonstrated that a station furnishing single-phase currents for lighting and three-phase currents for power can be used as well to operate single-phase railways without the use of converters or special alternate-current machines.

From the switchboard the high-tension conductors rise immediately toward the distributing tower, after traversing, on an intermediary floor, the lightning arresters and high-tension fuses. The 6,600-volt conductors are carried from the power station on wooden poles, special double-pole conductors leading to each of the four transformer stations which are provided for the operation of the railway. The four stations work in parallel on the network, and the same type of transformer, each of seventy-five kilovolt-amperes, has been used throughout; the station I having one, station II, two; station III, three, and station IV, two such transformers.

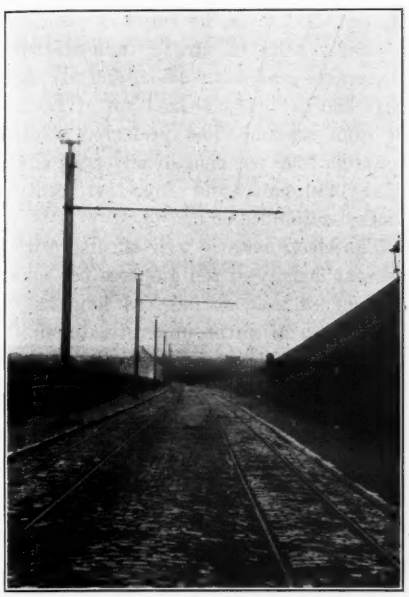


Arrangement of Trolley Wires, Single-Phase Railway System of the Borinage.

The stations are small masonry buildings of about 3.2 metres by 2.4 metres floor surface, and in addition to the transformers contain any necessary switching apparatus. The high-tension conductors first traverse two separating hand switches and then an oil-switch, whence they are conveyed toward the high-tension bus-bars. From the latter the current is led through fuses to the primary transformer

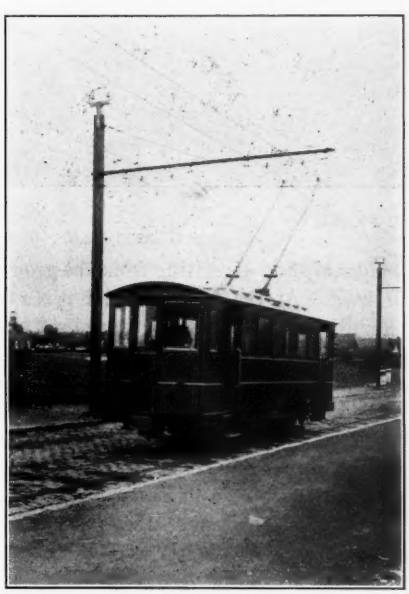
side. The secondary end of the transformer is also protected by fuses, and the leads connect to bus-bars and a common switch.

Though in the case of single-phase rail-



DOUBLE-TRACK, SINGLE-PHASE RAILWAY SYSTEM OF THE BORINAGE.

ways, one trolley wire for each track is quite sufficient, using the rails as return, the Société Nationale had prescribed the use of double-pole trolley wires, prohibit-



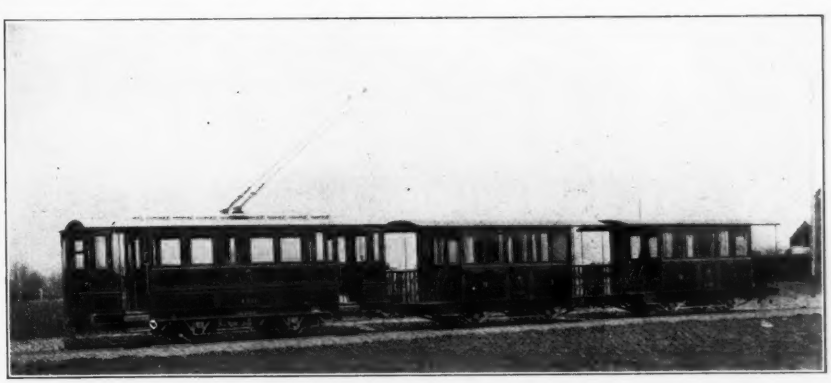
MOTOR-CAR, SINGLE-PHASE RAILWAY SYSTEM OF THE BORINAGE.

ing any use of rails as current conductors. The reason for this was the existence of telegraph and telephone lines with earth returns in the neighborhood of the railway system, the operation of which should not be interfered with by earthed traction currents.

The two trolley wires were laid out at ninety centimetres apart so as to have their lowest point lie at six metres above the upper edge of the rails, excepting at viaducts.

The wires are grooved of hard-drawn copper having equivalent cross-sections of 100 square millimetres each. Double T-girders have mostly been used as poles, wooden poles being objectionable owing to their relatively short life, while lattice-work poles or tube poles would have proved too expensive. The poles adopted gave every satisfaction, their aspect being by no means ugly, especially after fitting the brackets and wires. In most cases the wires were suspended from brackets made of two U-shaped irons.

The pressure on the trolley wire being only 600 volts, the wires could be suspended in the manner generally used in connection with tramways, using the new track material of the Allgemeine Elektricitäts Gesellschaft. The trolley wires were clamped throughout. With a view to ensure a most satisfactory insulation between the two poles, a ball insulator was placed in the steel wire between such insulator holders as were fitted already with insulating bolts, thus obtaining a triple insulation of the two poles with regard to one another and double insulation between the wires and the ground. In each section of 500 metres a double-pole lightning arrester has been installed. In order to avoid any insulated crossings in connection with switches, the polarity of the two wires of any branched track was changed while the two traversing wires of the main track were allowed to keep their polarity. Section insulators were fitted for the purpose into the two wires of the branched track immediately behind the overhead switches (between the latter and the crossing of the wire); the two wires which cross have thus the same polarity.



MOTOR-CAR AND TRAILERS, SINGLE-PHASE RAILWAY SYSTEM OF THE BORINAGE.

For the actual operation of the system, twenty motor-cars and a corresponding number of trailers were constructed, the cars being supplied by the Société Anonyme Franco-Belge, while the electrical machinery was furnished by the Allgemeine company. Like all the cars of the Société Nationale these cars are rather simple in design, the lines being mostly intended for workmen's traffic. The car-body is about 4.7 metres in length, the two platforms which are fitted with solid walls on the front sides being 1.3 metres in length. Six movable windows have been supplied. The seats are longitudinal and are intended for twenty passengers, twenty standing places being likewise provided for. The cars have no special truck, the axle boxes being fitted immediately to the longitudinal beams of the body. The car-body is fitted with double springs, *viz.*, with both spiral and elliptical springs. The wheel-base is 2.4 metres, the wheel diameter 800 millimetres, and the gauge one metre.

The electrical equipment of the motor-cars consist of two motors, one regulating transformer, two traction switches and one separate motor cutout, two automatic switches, two hand switches, one main fuse, one double-pole lightning arrester, the braking resistance, an electrical lighting outfit and two current collectors.

The motors are Winter-Eichberg motors of the WE 31-B type of forty horse-power capacity each, designed with six poles for forty cycles and a mean pressure of 550 volts. The motors work in the usual way on the running axle with a ratio of transmission equivalent to 1 : 5.07.

The motors have a closed housing consisting of two parts, one of which can be swung down. This housing has openings provided with covers, so as to make the commutator readily accessible. The laminated stator consists of two parts, has a single-phase, six-pole winding, distributed in slots, while the rotary has

two systems of brushes, *viz.*, short-circuit and exciter brushes respectively, the positions of which are displaced electrically by ninety degrees with regard to one another. The motors rest on the running axles and are also suspended by means of springs and flat iron transverse beams from the longitudinal beams of the car.

The regulation is effected by series-parallel arrangement in connection with a regulating transformer, only the arrangement of the stationary windings being altered, while that of the rotors is left constant; these are permanently connected up in series. The regulating transformer has been designed as an autotransformer, no resistances being used in starting. It is air-cooled and is suspended by means of bolts from the bottom of the cars upon transverse beams carried by the longitudinal car beams.

The controllers are of the B-19 type. They contain a large and a small cylinder and are used for short-circuit and counter-current braking. The large cylinder serves for operation and braking and has two series and three parallel steps effecting the alteration of the ratio of transmission on the regulating transformer, in addition to five braking positions for short-circuit braking where the motors work as generators on resistances and a sixth braking position for counter-current braking. The smaller cylinder serves to reverse the direction of rotation.

Owing to the double-pole trolley wires, the motor-cars have been provided with two current collectors, being standard railway collectors mounted in the middle of the car opposite one another 900 millimetres apart. The ends of the rods are insulated by leather for about 1.5 metres.

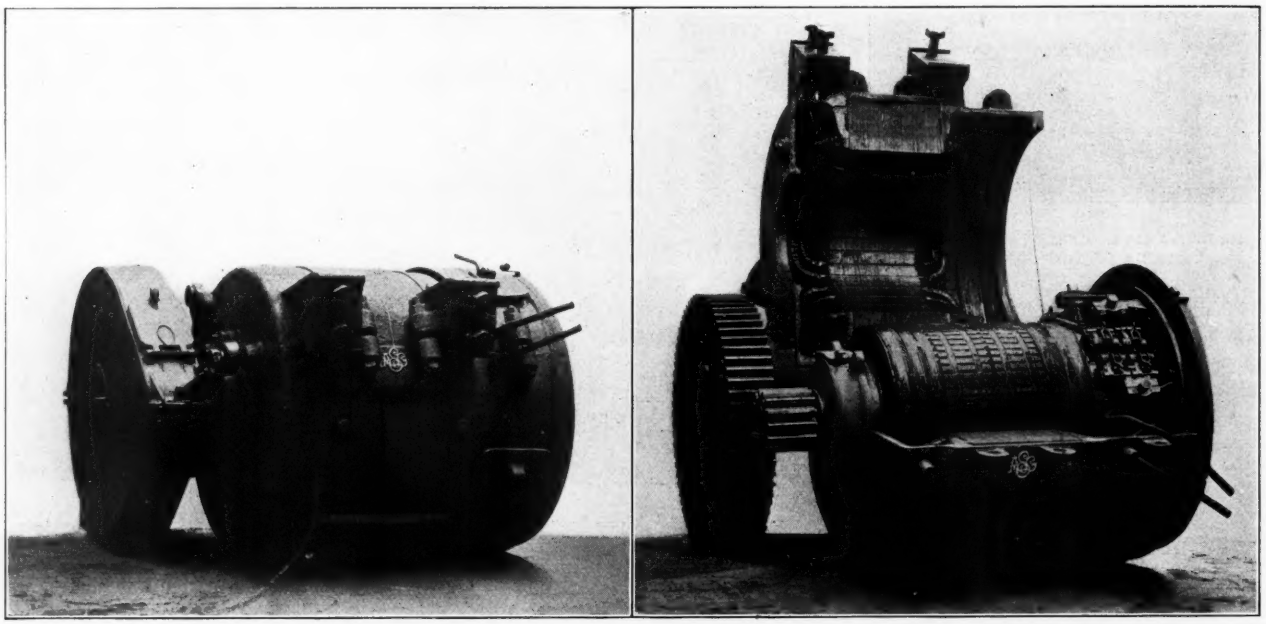
Each of the lines starting from the two-current collectors is protected against atmospheric discharges by an inductive coil and a lightning arrester, the two lightning arresters being combined into a double-pole lightning arrester of standard construction with carbon resistances. The main circuit further contains two automatic switches, two hand switches, one on each of the platforms, and one main fuse. The braking resistances are arranged under one of the platforms, and are standard resistances as used in connection with continuous-current tramways.

Six glow lamps arranged in series are used to light the cars. The weight of a complete motor-car without its passengers is 9.95 tons, of which 3.7 tons correspond to the electrical equipment. The motors weigh 1,385 kilogrammes, and the regulation transformer 260 kilogrammes. The trailers used have accommodation for forty passengers like the motor-car and have a weight, when empty, of four tons.

A provisional shed has been erected consisting of a wooden hall to accommodate twelve motor-cars, a workshop and store and two office rooms, the trailers being installed in the courtyard. The permanent station building is to be erected at the juncture of the two main lines, Quaregnon-Eugies and Eugies-St. Chislain.

All the results so far obtained in course of operation are extremely satisfactory, not the least hitch having ever occurred.

The writer is indebted to the courtesy of the Allgemeine Elektricitäts Gesellschaft for kindly supplying the above data as well as the photographs herewith reproduced.



Motor and Gear Case, and Motor Interior Exposed. Single-Phase Railway System of the Borinage.

Silver Electrolytic Refining.

A new method of refining silver electrolytically (especially applicable where bismuth, antimony, etc., are present) has been described by Anson G. Betts, of Troy, N. Y. (U. S. patent No. 795,887). As the electrolyte, he employs a solution of silver salts of strong, non-oxidizing, preferably monobasic acids, and also adds 1:12,000 or 1:15,000 solution of gelatine or gum arabic. The preferred solution contains four per cent of silver, as silver-methyl-sulphate, and four per cent of methyl-sulphuric acid.

The electrolysis is well effected with a current density of ten amperes per square foot of cathode surface, as long as the high value of silver under treatment demands, say, forty-eight hours, without danger of short-circuiting from the growth of trees. As the deposit is not perfectly solid, it may be easily scraped off the cathode sheets, which can thus be used over and over. No silver falls from the cathodes into the tanks, unless it is knocked off by carelessness. No necessity exists for wrapping the silver anodes in cloth, as is common in electrolytic-parting processes; for, whether the anode slime (mostly of gold) drops from the anodes or remains sticking to them, it can not become mixed with the cathode silver.

The strong non-oxidizing, monobasic acids dissolve the bismuth salts, and the bismuth is recovered by precipitation with metallic lead. The resulting lead solution can be treated with finely divided silver-sulphate, precipitating lead sulphate and regenerating silver solution to be used over again.—*Engineering and Mining Journal.*

WATER POWER AS A FACTOR IN INDUSTRIAL DEVELOPMENT.

BY CHARLES H. BAKER.

Many centuries ago, in a prehistoric era, the earth was chaos. Following this the forces of nature began to operate, and the heat of the sun caused the earth to take on its surface the plumage of a luxurious vegetation, now known only to the students of geology. Then came fire and destruction and earthquakes and upheavals, burying the forests and plant life of that remote era and giving place to a new generation of vegetable and animal life. These periods were repeated as the centuries went by, one geological age succeeding another, but each one storing in the bosom of the earth the carboniferous substances and latent heat, which during the process of subsequent centuries has given birth to the modern coal fields of the world. Then, through the invention of James Watt and the development of steam machinery which has followed, this fuel has become a source of power to drive the various engines and machinery used in the mechanical arts.

Now, at the present time, the same sun which warmed into life the plants and animals of several thousand years ago, to-day uplifts from the oceans the water thereof in the shape of vapor and clouds, and this same sun, by virtue of its radiant heat, unsettles the atmospheric equilibrium so that winds result, and by them the clouds are driven from over the ocean and intercepted by the mountain peaks, the moisture is precipitated in rain or in snow which is stored upon the mountain slopes and in the hills and valleys, all of which gives rise to the little rivulets which in turn unite and make great rivers. And then the attraction of gravitation draws these rivers downward to the sea, falling, gushing, tumbling over precipices in their incessant effort to reach the ocean level again; the process repeated again and again forever.

In the one case is the latent energy of coal, the work of thousands of years to conserve; in the other is the energy of falling water, the work of a few hours. The efforts of the ancient and the modern sun stand face to face, and with what relative results? Out of coal we get perhaps ten per cent, in the form of mechanical power, of the energy which is stored within it. Out of falling water we get sixty-five per cent, even after subtracting the losses due to electrical transformation and transmission. In the case of coal we have to dig and mine and transport it, shovel it through furnaces, and rake out the ashes, all of which keeps busy an army of men. In the case of falling water the development of the power is largely automatic, the fuel bill for all time is probably part of the original installation cost, the labor is reduced to a minimum, and the cost proportionately. It is therefore apparent that an industrial community, having a water power at its door, under a liberal license, will thrive as against a community depending upon the coal fields, similarly situated and conditioned.

It is interesting to note in this connection the evolution of the motor from the primitive stage down to its present form. The prime motor is, or was, either man himself, or the beast of burden. M. Charvet, who has studied the subject, finds that a French laborer working eight hours in turning a crank at a wage of seventy cents per day, produces one horse-power unit, the cost of which is eighty-five cents. The ox, turning a horizontal bar thirteen feet long, as in some grinding mills, produces the horse-power unit in the same length of time at a cost of twenty-three cents. A horse, doing the same kind of work, travels much faster than the ox, and his unit of work costs a little less than twenty cents. But a steam engine, working one hundred and fifty days a year, ten hours a day, as is customary in farm work, reduces a unit of work to the cost of four cents. A petroleum engine is considerably more economical, but in France this work costs seven cents on account of duties. A windmill produces a unit of work at two cents, but a water wheel, the cost of whose installation is $160 per horse-power, can produce the unit of work as a constant quantity as low as one cent. It is readily seen, therefore, how a community backed by an economical and up-to-date water power can maintain its commercial existence as against another community in the same business, the members of which furnish their own labor, or employ beasts of burden, or run steam engines. Power is a component part of the cost of anything which is made. Every article, therefore, in daily use, which is a manufactured article, is the product of power and material, and the item of power in it is a factor of more or less extent. In calcium carbide, for instance, which has a general use, power makes up sixty per cent of the cost of the product; and, therefore, a carbide factory, or a similar industry, should be located next to a water power in order to thrive. Ordinary flour from which bread is made can be produced at a rate of four barrels a day for each horse-power employed in the work, and the principal cost of making flour is grinding the wheat. Therefore, if power is cheapened by the introduction of a natural water power, bread foods are cheapened in consequence, and in the case of the flour mills at Seattle, for example, this item of cost has been cut in two since the advent of power from Snoqualmie Falls. If an article is cheapened by virtue of cheapening the cost of power, or by cheapening any other component part which goes to make up the cost of the article, then more of that article will be used, and a broader market for it will be obtained, more people will find employment in its manufacture and a larger and more prosperous community will result. Power, therefore, in its cheapest form, which must of necessity be from falling water, is the underlying force which will give health, vigor, strength and prosperity to an industrial community. Of two manufacturing communities, manufacturing the same article and for the same market, if one is able to secure an advantage over the other of only a few per cent, either in the item of power, or in the raw product, then the community which possesses this advantage will drive the other to some other line of business.

On Puget sound, accessible by ocean commerce to the world's markets, where the differential obtained by the use of falling water as a power agency is from twenty to fifty per cent, is it not reasonable to predict an industrial growth in consequence thereof, which will make the cities affected by it sovereigns among those of the manufacturing world? Will not more people enjoy the luxury of electric illumination in their homes in consequence thereof, where several lights are available for the price which formerly prevailed for one light? Electric light is power, light being simply a different manifestation of power. As the cost of light is made up principally of the cost of power, and incidentally of the cost of selling and distributing it, cheaper power therefore establishes a price on such a luxury which will make it possible of enjoyment by a wider range of people. It is power also which propels street cars and interurban trains, transporting people from one place to another in a convenient fashion. Power is the principal item entering into the cost of serving this transportation, and if this factor of cost is lessened it then becomes possible to carry more people in comfort for less money.

A city, therefore, which offers these

[1] Paper read before the general engineering section of the Pacific Coast Engineering Congress, Portland, Ore., June 29-30, 1905.

utilities upon a more plentiful and cheaper scale than do other cities, would naturally gather to itself an ever-increasing population. Observe what Niagara has done for Buffalo and other places to which the natural power of that great cataract has been made tributary. Manufacturing and industrial establishments have broadened the scope of their operations, and concerns from other parts of the world have been attracted there. This has increased the wealth of the section benefited by bringing the theretofore waste power of Niagara into the markets of the world in the shape of manufactured products and bringing back the gold of the world in exchange therefor. Increased employment has been furnished for labor, and the population of the cities has been increased and new centres of population and wealth have been established thereby. This is an object lesson which applies as well under the shadow of Snoqualmie Falls, or wherever inexpensive and practical water power exists, as at Buffalo.

A manufactured article is the product of material and power. If the mass is great the motion is small, and if the mass is small the motion or speed is great. There are myriads of small manufactured articles where the raw material is insignificant, but where the machine work or power is considerable; and, therefore, the largest factor in making up the cost of the finished product. On the contrary, where the mass or material is great, the power is generally small. All these give employment to the natural power and the skilled mechanic. The raw material is made into salable form and finds a market throughout the world, and the gold of other states and countries, where it finds its market, comes into the manufacturing community in return for the article sent out, and thus wealth accumulates. Industrial communities are always thrifty; the people are happy and contented, unless labor agitators intrude; they are constantly growing in wealth, contentment and independence, and the savings banks have nearly as many deposit accounts as there are workers in the community. Thus it is that the ingenuity of man has contrived to enable him to keep a hand upon the throttle of one of nature's most powerful forces, to use it as he wills, and so to multiply many fold his share of the world's work.

Ohio Society of Mechanical, Electrical and Steam Engineers.

The annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at Canton, Ohio, November 17 and 18, 1905. At this meeting there will be an election of officers, and also discussion on some proposed changes in the constitution.

Practical Standards for Electrical Measurements.

At the recent meeting of the British Association for the Advancement of Science, held in South Africa, the committee charged with investigating the construction of practical standards for electrical measurements submitted the report which follows. The chairman of the committee is Lord Rayleigh and Dr. R. T. Glazebrook is the secretary.

The committee is glad to report that satisfactory progress has been made during the year with the ampere balance. The weighing mechanism was taken over from the maker shortly after the last meeting of the association, and the work on the coils completed at the National Physical Laboratory. The labor involved in insulating the two wires on the large cylinders was very great. Each wire consists of about ninety turns of about 103 centimetres circumference. Thus each wire is about ninety-three metres in length, and the two are along their whole length about one-tenth millimetre apart. In the coils as finally set up the insulation resistance between these two wires is measured in thousands of megohms, and is thus amply sufficient. The cost of the balance has amounted to £302 6s., the excess over the £300 granted for the purpose being met out of the general fund at the disposal of the committee. Calculations of the force to be expected between the coils when carrying one ampere have been made by Mr. Mather and Mr. F. E. Smith, of the National Physical Laboratory, and are in close agreement.

The designs from which the balance has been made are the work of Mr. Mather, and originally it was contemplated that the balance would be set up at the City and Guilds Central Institute, in Exhibition road. At a meeting of the committee held on March 31, 1905, however, this decision was modified, and the following minute agreed to: "that the ampere balance remains for the present at the National Physical Laboratory, and that a determination of the ampere be made with it there under the supervision of Professor Ayrton and Mr. Mather, steps being taken to connect closely with the determination and with any notification of the results the names of the late Professor J. V. Jones, Professor Ayrton, and Mr. Mather, to whom the design of the instrument is entirely due." Accordingly, the balance has been set up at the National Physical Laboratory, and a number of preliminary tests have been made. Particulars of some of these follow.

AMPERE BALANCE.

The weighing mechanism of the balance was erected by Mr. L. Oertling at the National Physical Laboratory in March of the present year, and the electrical equipment was completed immediately afterward. The four coils of bare copper wire wound on marble cylinders have given complete satisfaction, the ellipticity and conicality of each being very small. The average ellipticity is such that the diameters of the ellipse differ in length by about ten micron, while the average conicality is approximately represented by a difference between the mean diameters of two sections thirteen centimetres apart (the axial length of one coil) of about twelve micron. The contour of the cylinders is very well known, and the mean diameter has been measured with a probable error not greater than 0.001 per cent. This knowledge enables the calculation of the mutual induction between two coils to be made with great accuracy. Preliminary observations with a current of nominal value, one ampere, were made at various times during April and May, the first set of such observations determining the temperature to which the coils are raised by a continuous steady current, the magnitude of the disturbances arising from convection currents, the influence of the silver strips, and the nature of other disturbances. The convection currents give some trouble, but the experiments already carried out indicate that a change of 0.001 per cent in a current of nominal value one ampere will be detectable. The balance acts conveniently as an indicator of the magnetic permeability of the marble and metal parts of which it is constructed, and it is satisfactory to know that the permeability of these parts does not differ from unity by a measurable amount, and can not therefore influence the final results. Early observations showed that the concentric cable employed in the leads to the balance was faulty, some of the internal strands being broken, and the variable contacts thus resulting prevented a steady current from being obtained. Fresh concentric cable is being inserted, which should enable the final observations to be speedily made.

APPARATUS FOR THE DETERMINATION OF "G."

The three half-second pendulums (the property of the board of education, and which were used in the last Antarctic expedition) have been swung at Kew and at the National Physical Laboratory, in the room where the balance is erected.

The observations are being continued. When all the constants have been determined and the observations with the balance are complete, it will be necessary to consider the means by which the result is to be given to the world. The current may be reproduced either by means of the silver voltameter or by means of a standard cell and a standard resistance. The silver voltameter is being investigated at the National Physical Laboratory, and a comparison of the accuracies of reproduction would perhaps influence the choice. The committee was represented at the International Electrical Congress, at St. Louis, last year by Professor Perry and the secretary. The resolutions passed at the Cambridge meeting of the committee (see report for 1904) as to certain questions proposed for discussion were laid before the congress, and after discussion the following reports were unanimously accepted:

COMMITTEE OF THE CHAMBER OF DELEGATES ON INTERNATIONAL ELECTROMAGNETIC UNITS.

The subcommittee appointed September 13, 1904, begs leave to suggest that the chamber of delegates should adopt the following report: it appears from papers laid before the International Electrical Congress and from the discussion that there are considerable discrepancies between the laws relating to electrical units, or their interpretations, in the various countries represented, which, in the opinion of the chamber, require consideration with a view to securing practical uniformity. Other questions bearing on nomenclature and the determination of units and standards have also been raised, on which, in the opinion of the chamber, it is desirable to have international agreement. The chamber of delegates considers that these and similar questions could best be dealt with by an international commission representing the governments concerned. Such a commission might, in the first instance, be appointed by those countries in which legislation on electric units has been adopted, and consist of, say, two members from each country. Provision should be made for securing the adhesion of other countries prepared to adopt the conclusions of the commission. The chamber of delegates approves such a plan, and requests its members to bring this report before their respective governments. It is hoped that if the recommendation of the chamber of delegates be adopted by the governments represented the commission may eventually become a permanent one.

COMMITTEE OF THE CHAMBER OF DELEGATES ON INTERNATIONAL STANDARDIZATION.

The committee of the chamber of delegates on the standardization of machinery begs to report as follows: that steps should be taken to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery. If the above recommendation meets the approval of the chamber of delegates it is suggested by your committee that much of the work could be accomplished by correspondence in the first instance, and by the appointment of a general secretary to preserve the records and crystallize the points of disagreement, if any, which may arise between the methods in vogue in the different countries interested. It is hoped that if the recommendation of the chamber of delegates be adopted the commission may eventually become a permanent one.

The first of these reports, relating to the summoning of an international congress on electrical units, is now under the consideration of his Majesty's government. Meanwhile a preliminary conference of representatives of standardizing laboratories and others interested in the determination of electrical units has been summoned by the president of the Reichsanstalt to meet in Berlin in the autumn. Lord Rayleigh and the secretary have received invitations to be present. The object of this conference is stated to be that the institutions which are concerned in maintaining the accuracy of electrical measurements in conjunction with those scientists who have devoted especial attention to this field of work should exchange opinions, and, if possible, come to an agreement as to the measures which must be taken in order to obtain the international uniformity in electrical units and measurements which is desired. It is thus preliminary to the more formal consideration of the subject which would be the work of the international congress. One of the most important questions which will be discussed will be the specification of some form of standard cell. Work on this matter has gone on in America and at the National Physical Laboratory, and an appendix to the report by Mr. Smith contains a provisional specification. It is suggested that persons interested in the matter might help by setting up cells in accordance with this specification and submitting them for test at the laboratory. Of the grant made to the committee in 1904 a balance of £3 4s. 10d. remains. The work which remains to be done on the standard cell and with the ampere balance will all involve considerable expense, and to meet this the committee asks for reappointment, with a grant of £25 in addition to the balance now in its hands.

APPENDIX I—ON THE PREPARATION OF A CADMIUM CELL.[1]

BY F. E. SMITH.

The research on standard cells has been continued at the National Physical Laboratory on the lines indicated in the last report to the association. Taken as a whole, the results are very satisfactory, but it is thought desirable to continue still the observations on some of the older cells before publishing the results in detail. Mr. G. A. Hulett, of Michigan, has completed a chemical research on mercurous sulphate, which throws considerable light on the anomalies reported to the association last year. Very slight changes can still, however, be traced to this salt, but fortunately they are of no commercial significance. The twelve and one-half per cent amalgam also produces slight variations in the electromotive force of the cell. These, again, are commercially unimportant, and a manner of overcoming them in cells employed at a standards laboratory is indicated in this paper. The latter cells are set up with an amalgam entirely liquid at zero degree centigrade. At this stage of the research it is thought desirable to describe the methods by which the materials of the cell can be best prepared in the light of present information, and an appeal is made to those interested in the subject to set up one or more cells by these methods and submit them for comparison with the standards of the National Physical Laboratory. More light will thus be thrown on the slight discrepancies already referred to, and the degree of accuracy with which the cell can be constructed will be established. In this way it is hoped to specify a cell for commercial purposes accurate at all ordinary English working temperatures to one part in 2,000, applying no temperature correction, or to one part in 10,000 if the temperature correction be applied. In the specification which follows there are four methods of preparing the mercurous sulphate. The first of these is due to Professor H. S. Carhart, Mr. G. A. Hulett, and Dr. F. A. Wolff; the main features of the second method were suggested by Mr. Swinburne to Dr. Glazebrook, while the third and

[1] From the National Physical Laboratory.

fourth methods have resulted from some experiments at the National Physical Laboratory. It is suggested that one only of these methods be eventually employed; the observations on submitted cells will largely determine the choice.

PREPARATIONS OF MATERIALS FOR A STANDARD CADMIUM CELL.

1. Mercury—The commercial mercury should be squeezed through wash leather and passed in the finely divided condition in which it emerges, first through dilute nitric acid (one to six of water) and mercurous nitrate solution, and afterward through distilled water, both liquids being conveniently contained in long glass tubes. The mercury is then to be twice distilled *in vacuo*. Mercury suspected of abnormal contamination should not be employed.

2. Amalgam. Type A—This is a twelve and one-half per cent amalgam, and is intended for all commercial cells. The method of preparation is practically identical with that used by Professor Carhart. A current is passed from a thick rod of pure commercial cadmium to distilled mercury, the intervening liquid being cadmium sulphate solution rendered slightly acid with a few drops of H_2SO_4. The cathode is weighed before deposition takes place, and again afterward, the percentage of cadmium in the amalgam being thus calculable. More than the requisite amount should always be deposited, and the percentage reduced to twelve and one-half by the addition of more mercury. The fall of potential from anode to cathode should not exceed 0.3 volt. To prevent the anode slime having access to the cathode it is desirable to surround the anode with a small porous pot, as in the Richards silver voltameter, or to place a small crystallizing dish beneath it for the anode powder to settle in. Contact with the cathode is made with a platinum wire sealed into a glass tube so as to protect it from direct contact with the cadmium sulphate solution, and a rough estimate of the quantity of cadmium deposited is obtained from the readings of an ammeter placed in the circuit. The amalgam so prepared, together with the mercury added to reduce the percentage of cadmium to twelve and one-half, is now heated on a water bath and stirred so as to ensure homogeneity, some cadmium sulphate solution still flooding the surface. It is then cooled, and the acid sulphate removed, neutral cadmium sulphate solution taking the place of the latter, and consisting of saturated solution plus an equal volume of distilled water. This twelve and one-half per cent amalgam is then ready for use and is entirely liquid at a temperature approximating to sixty degrees centigrade.

Type B—This amalgam is liquid at the temperature of melting ice, and is intended for cells of a slightly better type than those made with the twelve and one-half per cent amalgam. The cells may be used at a higher temperature than zero degree centigrade, but they are not intended to be so used, as their temperature coefficient is about 0.043 per cent per rise in temperature of one degree centigrade. The cells are primarily intended for standardizing laboratories, and their electromotive force at zero degree centigrade is equal to the electromotive force of the cells prepared with the A amalgam if this latter electromotive force is corrected to zero degree centigrade with the temperature coefficient formula of the cell. This is equivalent to saying that if an A cell was in a steady condition at zero degree centigrade, and nothing abnormal occurred, its electromotive force would be identical with that of a B cell at zero degree centigrade. It is not wise, however, to use a twelve and one-half per cent amalgam cell at low temperatures. An eight per cent amalgam may be so used, but its upward range (with a small temperature coefficient) is lower than that of the twelve and one-half per cent amalgam cell. For commercial purposes probably the twelve and one-half per cent amalgam will be of most service. To prepare the type B amalgam, take some of that previously prepared and add sufficient mercury to reduce the percentage of cadmium to three. The amalgam will now be entirely liquid at ordinary working temperatures. On cooling, a crystalline amalgam separates from the liquid, and will continue to do so as the temperature is lowered. Cool the amalgam to the temperature of melting ice and remove the mother liquid; this is the amalgam desired. It is important that the temperature be truly that of melting ice, and that no solid is removed. For convenience the three per cent amalgam may be placed in a tubular vessel well surrounded with ice shavings; a long very fine capillary tube reaches to the base of this vessel, and through it the liquid at zero degree centigrade is removed by suction. Some solid must be left behind, or otherwise there is no certainty of saturation. Throughout all the operations neutral cadmium sulphate solution must cover the surface of the amalgam and wet all vessels, tubes, etc., through which the amalgam passes. Otherwise the amalgam will leave a "tail," and its composition may possibly be thereby changed.

3. Cadmium Sulphate Crystals and Solution—Procure commercially pure cadmium sulphate ($CdSO_48/3H_2O$). Dissolve in about one and one-quarter times its weight of distilled water, agitating either continuously for about six hours or occasionally for two or three days. Filter through a fine-grained filter paper so as to ensure a clear solution, which should then be placed in a number of crystallizing dishes and evaporation allowed to take place slowly at a temperature not exceeding thirty-five degrees centigrade, when, provided that dust be excluded, many transparent crystals of $CdSO_48/3H_2O$ will result. These should be prevented as much as possible from adhering to one another by removing the liquid to other dishes as soon as the crystals are of such a size that most of them are in contact. In this way about five-sixths of the liquid may be evaporated, the mother liquid being employed for a preliminary washing of the mercurous sulphate, the manufacture of which is afterward described. The crystals of cadmium sulphate so obtained should be washed with successive small quantities of distilled water until after standing for five minutes no trace of acidity can be detected with congo red. The crystals, still moist, may then be transferred to a stock bottle. To prepare the final solution agitation with distilled water is recommended as before, the temperature being preferably five degrees or ten degrees higher than the normal temperature, so as to ensure saturation. On no account should cadmium hydroxide be employed to neutralize the first solution, which is invariably acid; nor, indeed, should any attempt be made to neutralize the solution except by crystallization.

4. Mercurous Sulphate—The preparation in each case is to be conducted in a darkened room.

(*a*) Electrolytic Method—Pure distilled mercury forms the anode and platinum foil the cathode, the electrolyte being dilute sulphuric acid (one part by volume of concentrated acid to five parts of distilled water). The mercury is preferably placed in the base of a large flat-bottomed beaker, and about twenty times its volume of the dilute acid added. Contact with the mercury is effected by means of a platinum wire passing through a glass tube, while the cathode is suspended in the upper portion of the liquid. During the electrolysis the electrolyte must be continually stirred, an L-shaped glass stirrer being most efficient, the L portion being

placed near the surface of the mercury. A current density of about 0.01 ampere may be employed. The salt so prepared is treated as per note A.

(*b*) Precipitation method, mercurous nitrate and sulphuric acid being employed. Add strong nitric acid to a little pure mercury contained in a crystallizing dish, and place in a draught chamber until the action is over. If any mercury remains, add more acid and continue to do so until the mercury has completely disappeared and a strongly acid solution assured. Prepare dilute H_2SO_4 (one to four by volume), allow to cool, and then add the acid nitrate solution drop by drop, keeping the mixture violently agitated. Mercurous sulphate is precipitated, which should be filtered and treated as per note A. No more nitrate solution must be added to the dilute H_2SO_4 than will suffice to neutralize thirty per cent of the H_2SO_4 present. The maximum amount it is permissible to add may be estimated by taking a small portion of the dilute H_2SO_4 and adding the nitrate solution until no further precipitation results. The proportion of nitrate solution to dilute H_2SO_4 in such circumstances must be reduced to one-third its value for the preparation of mercurous sulphate by method *b*.

(*c*) Precipitation method, strong and dilute sulphuric acid being employed. Purchased mercurous sulphate is warmed with pure strong H_2SO_4 and a little mercury to a temperature of about 150 degrees centigrade for about ten minutes, the operation being conducted in an evaporating dish covered with a clock glass and the mixture kept well stirred. The suspended matter is then allowed to settle, the hot liquid cooling sufficiently meanwhile for the vessel to be handled with comfort. The clear acid is then poured into dilute H_2SO_4 (one to six), when crystalline mercurous sulphate separates out. About ten times the bulk of dilute acid should be employed, and to avoid spitting the hot liquid should be poured through a funnel, having its stem immersed in the dilute acid. The mixture is well stirred, cooled, and filtered, and the salt treated as per note A. As the operation yields but a small quantity of the salt it is advisable to repeat several times.

(*d*) By means of Nordhausen sulphuric acid. Place distilled mercury in the bottom of a beaker or bottle to the depth of about three millimetres. Add about four times its volume of Nordhausen sulphuric acid and stir well, keeping the mouth of the bottle closed as much as possible, as the acid fumes are very unpleasant. Mercurous sulphate is formed in the cold and appears in the crystalline form after a few minutes. Allow the operation to continue until the acid strength has been considerably diminished; then pour into dilute H_2SO_4 (one to six). Considerable spitting always occurs, so that caution is necessary. Proceed with the product as per note A.

Note A—The mercurous sulphate obtained by the foregoing methods is first agitated with dilute H_2SO_4 (one to six) and distilled mercury. It is then filtered (a small Gooch crucible and filter flask are convenient), and the greater part of the mercury removed, as it interferes with the filtering. The salt is next washed with small quantities of saturated cadmium sulphate solution until free from acid. For the first few washings some of the first acid solution may be employed, but the final washings must be made with a little of the neutral solution. Trouble is often experienced in ridding the salt prepared with Nordhausen sulphuric acid from all trace of acidity, and it is preferable to wash five or six times with the cadmium sulphate solution, and then place in a bottle together with a little of the solution, shaking from time to time and filtering again in a few days. The acidity of the washing liquid should be tested with congo red. Instead of washing with cadmium sulphate solution, sulphuric ether (water free) may be employed.

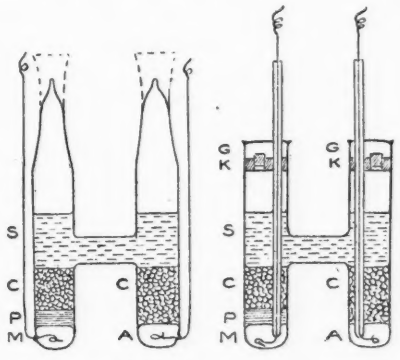


FIG. 1 AND FIG. 2.—H FORM OF CELL FOR STANDARDIZING.

The Mercurous Sulphate Paste—Some cadmium sulphate crystals are ground in an agate mortar with a little cadmium sulphate solution; about one-quarter their bulk of pure mercury is then added and two volumes of the acid-free mercurous sulphate, the whole being well mixed with cadmium sulphate solution so as to form a thin paste.

The Form of Cell—The H form of cell due to Lord Rayleigh is the most convenient, and is in general use. Two patterns have been adopted. In Fig. 1 a form is shown in which the electrodes are sealed into the lower ends of the two vertical limbs, while in the form shown in Fig. 2 the electrodes pass through glass tubes, into the lower ends of which they are sealed. Form 1 can be hermetically sealed, and is intended to be immersed in an insulating liquid. Form 2 is sealed with marine glue, and may be immersed in ice or water. The hermetical sealing of form 1 was suggested by Lord Rayleigh and by Professor Carhart. The glass tubes through which the electrodes are introduced in form 2 pass through corks which have been previously boiled in water and soaked in cadmium sulphate solution; in addition to the hole allowing of the passage of the electrodes, a second hole is bored through these corks for the passage of small glass pipettes. After the cell is filled these additional holes are fitted with small corks, and the cell is finally sealed with marine glue. The position of the various parts is shown in the figure. In filling the vessels it is convenient to use small pipettes made of two glass tubes, the one about three inches long and one-half inch in diameter, and the other about two inches long and one-third inch in diameter. If the larger tube has one end drawn out in the form of a cone, a junction is easily made. The amalgam of type A is melted over a water bath (its surface being flooded with dilute cadmium sulphate solution), and is introduced by means of a previously warmed pipette into one of the limbs. After the amalgam has solidified this limb should be washed out with a little fresh cadmium sulphate solution. If the amalgam of type B is used this washing is unnecessary. The mercury is next introduced into the other limb, then the paste, using if necessary a tiny glass rod as a piston through the pipette, and afterward a thick layer of finely pounded crystals is introduced into each limb. Saturated cadmium sulphate solution is finally added. The cells are then to be exposed in a warm room for a week or more to allow some of the liquid to evaporate, and so loosely cement together the fine crystals. This crystalline plug keeps the contents in their proper places, and enables the cell to be transmitted through the post. The sealing of the cells is next completed, care being taken not abnormally to heat the contents.

Cells which are submitted for comparison with the standards of the National Physical Laboratory should be accompanied with the following particulars: (1) maker's name and address; (2) name of the firms from whom the chemicals used in the manufacture of the materials were purchased (this information is only required so that the number of different sources of the materials can be estimated); (3) number of the method employed in the manufacture of the mercurous sulphate; (4) type of cadmium amalgam used; (5) notes on any peculiarities observed in the preparations.

American Electrochemical Society.

Eighth General Meeting Held at Bethlehem, Pa.

MONDAY MORNING SESSION.

THE eighth general meeting of the American Electrochemical Society was opened on Monday, September 18, at Bethlehem, Pa. A meeting of the board of directors was held in the morning. The first business session of the society was called to order in the chemical laboratory of Lehigh University at 2 P. M., when Dr. J. W. Richards, as chairman of the social committee, welcomed the visiting members to Bethlehem and introduced President Drinker, who welcomed the society to Lehigh, saying that it was very pleasant to have this occur as his first official action as head of the university.

President W. D. Bancroft, on behalf of the society, thanked President Drinker and the local committee for their welcome.

The first paper to be considered at this meeting was entitled "Notes on Some Centrifugal Experiments with Colloidal Solutions," presented by Dr. W. S. Franklin and L. A. Freudenberger and read by the latter. It described experiments made to determine whether colloids could be precipitated by spinning the solution at high speeds. Complete precipitation was obtained when at the higher speeds. Drs. Richards and Franklin took part in the discussion.

Dr. Wilder D. Bancroft delivered a very interesting lecture on "The Chemistry of Electrochemistry," in which he endeavored to show that the reactions taking place during electrolysis were merely chemical and under proper conditions could be brought about by purely chemical means. He illustrated his reasoning by experiments.

The discussion was participated in by Messrs. C. J. Reed, A. G. Betts, Carl Hering, W. J. Richards, and C. F. Burgess.

Mr. A. G. Betts read a paper on "The Phenomena of Metal Depositing," in which he presented his views of the conditions which affect the quality of the deposited metal. The paper was discussed by Messrs. Burgess, Bancroft and Richards.

In the evening a very enjoyable reception was given by Dr. and Mrs. Richards to the visiting ladies (though unfortunately there were none) and their escorts. This was followed by a smoker at the Lincoln Republican Club.

TUESDAY MORNING SESSION.

Tuesday morning the second session was called to order at 9 A. M.

A paper by Mr. O. P. Watts, entitled "Notes on the Use of Aluminum as a Reducing Agent," was read by Dr. Richards. A paper describing a "New Gin Process for the Electrical Manufacture of Steel," presented by Mr. Gustav Gin, was also read by Dr. Richards. It was discussed by Dr. Leonard Waldo, Mr. Hering and others.

"An Electrolytic Process for Refining Silver," by Mr. A. G. Betts, was read by title.

This paper called attention to the two electrolytic refining processes, known as the Moebius process and the Balbach process, after the inventors, which differ in the means adopted to prevent the spongy silver deposits from reaching the anodes and short-circuiting the cells. Certain objections to these processes appear, among which are the ungainly apparatus used, the high resistance of the solution, the collection of the silver in a loose condition, with consequent trouble, and the necessity of enclosing the bullion anodes in cloth bags to keep the gold out of the electrolytic silver. There are also certain chemical objections in the requirement of anodes practically free from metals other than copper and silver and the more precious metals.

The present progress in the recovery of silver is in the direction of collecting the silver of the ores ultimately as an anode slime from the electrolytic refining of base metals. This anode slime will contain the bismuth of the ore, and this is at present mostly wasted, the amount thus lost apparently being considerably greater than the total present consumption of the metal. A brief outline of the Betts process is published on page 470 of this issue.

Mr. F. D. Easterbrooks read a paper entitled "Electrolytic *vs.* Sulphuric Parting of Bullion." It was discussed by Messrs. Betts, S. S. Sadtler and Richards.

Mr. Maximilian Toch, in a paper on "Insulating Paints," discussed the problem of protecting metals from electrolytic corrosion and said that he had found that if the basic formula of the organic compound, the oil or gum, were known the behavior of the paint could be predicted. The paper was discussed by Messrs. Hering, Burgess, Sadtler, Bancroft and others.

A paper entitled "The Utilization of Active Oxygen, Chemically and Electrically Produced," was read by Mr. R. von Foregger and discussed by Messrs. Richards, C. A. Doremus and others.

Professor C. A. Burgess read a paper entitled "Some Observations on the Influence of Arsenic in Pickling Solutions."

A sulphuric acid pickle which exerts a vigorous dissolving action upon an iron or steel surface may be rendered almost completely inert by the addition of a small amount of arsenic. Over a half century ago this fact was pointed out by E. Millon, who, however, did not attempt to explain why a trace of arsenic has the property of exerting this remarkable protective action. This phenomenon is of considerable significance to the chemist and the electrochemist, for it indicates that arsenic is a disadvantageous impurity where free and rapid action of sulphuric acid upon iron is desired. A number of experiments upon the effect of arsenic in sulphuric acid solutions were performed in the applied electrochemistry laboratories of the University of Wisconsin. These experiments show that the effects of arsenic are sufficiently pronounced to warrant a further experimental study, especially in determining the quantitative effect of varying percentages of arsenic in various strengths of acid solutions. By some the presence of arsenic is held to exert a deleterious influence; that its presence in pickle gives rise to dark and irregular colorations on the surface of iron articles subjected to its influence, thus adding to the difficulties inherent in the process of preparing surfaces for receiving electrodeposits. Another disadvantage attributed to arsenic is that it makes the useful action of the solution exceedingly slow. On the other hand, it is claimed by Meurice that the presence of arsenic may be decidedly advantageous to an acid pickle, since, when present in suitable proportion, it reduces the consumption of acid, while increasing the effectiveness of its work.

A paper by Messrs. O. W. Brown and W. F. Osterle, on the "Electric Smelting of Zinc," was read by Mr. Sadtler, and discussed by Messrs. W. McA. Johnston, Richards and others.

The final paper for this session, by Mr. A. G. Betts, and entitled "Notes on

the Electrometallurgy of Antimony," was read by title.

This session was followed by a lunch to the society, given by the university in the gymnasium. The members were then shown through the electrical engineering laboratory by Professor Wm. Esty, and through the physical laboratory by Dr. W. S. Franklin.

In the afternoon a visit was paid to the zinc works and to the Bethlehem Steel Company.

In the evening a subscription banquet was given at the Eagle Hotel.

The Railway Signal Association.

The annual meeting of the Railway Signal Association will be held at Niagara Falls, N. Y., on October 10, 11 and 12. The association's headquarters will be established at the International Hotel. The sessions will be held in Assembly Hall connected with the Cataract and International hotels. There will be three sessions on October 10, two on October 11 and one on October 12. Arrangements have been completed for a special room which will be assigned for the displaying of such articles and appliances as may be deemed desirable to submit to members of the association. It can be occupied by any member after 10 A. M., October 10, until 6 P. M., October 12. This is a new departure for this association, and it was deemed advisable after due consideration of a number of requests for such space.

At this annual meeting the secretary will display samples of designs and metals for a permanent badge, medallion or button of the association. The following material will be offered for discussion: the word "Function" does not appear to cover the various articles to which it refers, and it is proposed to make an effort to substitute the word "Unit" for "Function."

The following topic is also submitted: "What Is the Best Method for Adjustment of Cost of Maintenance, Operation and Inspection of Joint Interlocking Plants?" Committee No. 2, which covers circuits for manual block signal systems, presents a good report and makes recommendations. Committee No. 5, "Organization of Signal Department," will present an exhaustive report with recommendations for a proper organization. Committee No. 6, "Cost," furnishes a report. Committee No. 8, "Standard Specifications," submits a substitute, a new table, for table "R," as printed in 1904 proceedings, beginning with paragraph 60 and ending with the completion of specifications which will be considered for final adoption. Committee No. 12, "Signal Lamps—Designs; Oil Used in; Care of, etc."—this committee makes a very exhaustive study of the long time and one-day burners as used in the various designs of top and bottom draft lamps, also their relative effect for range as relating to sight for enginemen approaching signals. A number of track tests under variable weather conditions are recorded and recommendations presented for consideration. Committee No. 13, "Wire—Rubber-Covered Insulated Wire," will make a preliminary report and some recommendations. In addition to these committee reports, Dr. Charles H. Williams, of Boston, will present a paper on "Observations on Signal Lenses." Dr. William Churchill, of Corning, N. Y., will present a paper on "The Roundel Problem." Mr. E. L. Adams, of the Lake Shore & Michigan Southern Railway, will present a paper on "The Use of Storage Batteries for All-Electric and Other Signal Devices." Dr. N. W. Black, of Milwaukee, Wis., presents his "Second Report of Comparative Tests of Roundels from an Opthalmologist's Standpoint." Mr. J. A. Peabody, signal engineer, Chicago & Northwestern Railroad, offers a paper on "Cost of Stopping Trains Compared with the Cost of Maintenance, Operation and Inspection of Interlocking Plants."

New Cable to China and Japan.

Mr. Clarence H. Mackay, president of the Commercial Cable Company, on September 14 gave out the following statement concerning the company's plans with regard to a new cable to China and Japan:

"Arrangements have been finally completed for the laying of submarine cables to China and Japan. It was the earnest wish of President McKinley, while the Pacific cable was in contemplation, that in addition we should lay cables to China and Japan. The difficulties at that time seemed insuperable, but we assured the President that we would do everything possible to comply with his wishes.

"Among our difficulties was a protest which Russia made against our laying a cable to Japan as being a breach of neutrality. President Roosevelt has given us his hearty support in order that American commerce might have quick service to China and Japan by an American cable.

"We also received the efficient aid of ex-Attorney General Knox and Attorney General Moody. Our landing rights in China were obtained several weeks ago and we have completed arrangements with the government of Japan for landing rights and connections in that country. Yesterday the agreement was signed by Mr. Takahira, the Japanese minister.

"We shall proceed at once with the manufacture and laying of these two cables, which will take several months. The Commercial Pacific Cable Company will then pierce the Far East at three points—namely, the Philippines, China and Japan. With the cable which has just been completed to Newfoundland, a fifth cable to Europe which will be laid this month, a cable from Guam to Japan and one from Manila to Shanghai we will have a system extending over two-thirds of the way around the globe."

The Commercial Pacific Cable Company has filed a certificate of increase of capital stock from $12,000,000 to $15,000,000, and an amendment to its articles of incorporation to provide that the company may make an extension from Manila, in the Philippine Islands, to Shanghai, China. The certificate is signed by Clarence H. Mackay and Edward C. Platt.

New Signal System for the Erie Railway.

A new automatic system of signals is to be installed on the Erie Railroad between Jersey City and Middletown, N. Y. This is an electric semaphore normally clear system, and is operated by stationary storage batteries. The signals will be put two-thirds of a mile apart for the first thirty-two miles, and one and one-third miles apart for the rest of the distance. Five power plants will be used for charging the batteries, which will be located at Rutherford junction, Ridgewood junction, Suffern, Oxford and Middletown. The most congested part of the Erie system is to be protected by the new signals. If it proves all that is claimed for it, extensions will be made over the entire line in the near future. The expenditure for the short line proposed will be $250,000.

Will Test Electric Meters.

In the absence of any appropriation with which to establish an electric meter testing station, Commissioner Oakley, of the department of water, electricity and gas of the city of New York, has reached a tentative agreement by which all such meters may be examined at the Columbia University laboratory. The university will maintain the station and furnish the necessary apparatus, if the city will pay half the inspector's salary. Commissioner Oakley has applied for authority from the board of estimate to make such an agreement.

Electrical Notes from Europe.

By Our Special Correspondent.

TELEGRAPH and telephone circuits are to be run through the Simplon tunnel to connect Switzerland and Italy, and the two governments are now coming to an understanding about the matter. No doubt the wires will be laid in underground cable in the tunnel. Each of the governments is to bear the expense for the lines according to the proportion of length which lies in the territory of each. The circuits will run from Brigue, on the Swiss side near the tunnel, to Domo d' Ossola, which is the present terminus of the railroad on the Italian side. At these stations the necessary telegraph and telephone apparatus will be placed, and this includes a set of public telephone cabins. The work of laying the cables in the tunnel will no doubt be carried out before the railroad line commences to run. The Swiss government has already allowed a credit of $50,000 for its share of the work.

On the Volga river an electrically operated freight boat is running between St. Petersburg and Rybinski, covering a distance of 600 miles or more. A somewhat novel system is employed in this case. The boat, or rather barge, is of iron construction and measures seventy-four metres long and ten wide. It has three helices, each of which is driven independently by a direct-current motor. Power is furnished by petrol motors which are mounted in the middle of the boat. Here are three Diesel engines of the four-cylinder type. They are direct-coupled to continuous-current generators, and the latter are used to furnish the current for the motors. By regulating the current it is easy to give the proper control for the helices. The dynamos also furnish the current for lighting, pumps and lifting-apparatus of the boat. A Swedish firm supplied the present outfit, at a cost of $30,000. By using steam engines alone the cost would have been one-third less, but it was desired to use oil, which is very cheap in this region, and on the other hand the combination system has several advantages in working. Besides, the boat can take a ten per cent higher load than if a steam plant were used, owing to the gain in weight. The Diesel motor uses crude oil, which yields 11,000 calories per kilogramme, and delivered at St. Petersburg costs but nine dollars per ton.

The Allgemeine Gesellschaft, of Berlin, is building a new steam turbine on the Schultz system which is said to give excellent results. On one of the recent trials which was made with one of the turbines connected on the same shaft with a dynamo, the latter was a three-phase alternator giving 550 volts and fifty cycles, running at a speed of 3,000 revolutions. The turbine and dynamo form a compact group five metres long and 2.2 wide. The two wheels of the turbine are placed on either side of the alternator. The turbine wheels measure 1.70 metres in diameter and make a peripheral speed of 267 metres per minute. A governor adjusts the speed within a five-per-cent limit between no load and full load when suddenly throwing on the load. Putting on twenty-five per cent of the load only gives a change of two per cent in the speed. On the tests the consumption of steam was found to be but 10.08 kilogrammes at full load, 10.49 at three-quarters load, and 11.26 at half load per kilowatt-hour.

In southern Switzerland it is proposed to secure a large amount of hydraulic power by using the falls of the Maria. As the stream affords a very irregular flow, to utilize it in a practical way it will no doubt be necessary to have a reservoir of large capacity which will afford the reserve supply. The most practical method seems to be to make use of a lake of some size which lies not far off, and the water from the river could be taken into the lake with comparatively little work, seeing that it would only be necessary to use a river bed which is now dried up and which would afford to some extent a natural canal. The level of the water in the lake varies only three feet or more during the year. In order to use it in the present case, they would raise the maximum level by less than three feet and lower the minimum level by some eight feet. When in the ordinary conditions of running, the level would remain constant in summer, and in the different seasons of the year it would allow the hydraulic plant to be operated in a satisfactory manner. To feed the natural reservoir which is thus formed, it is proposed to take off a part of the water of the Orlegna, which is an affluent of the Maria. The water would be brought to the lake through a canal a mile and a half long at a slight grade. Either a single large hydraulic station or two separate stations can be used to take the power which is thus afforded and which is estimated to reach a total of 43,000 horse-power, available during twenty-four hours per day.

Work on the new electric railroad which is to run to the top of Mt. Blanc has been commenced not long ago. The line starts from St. Gervais and climbs up the slope of the mountain as far as the peak which is known as Aiguille du Gouter. The route keeps along the northwestern side of the mountain. An altitude of 3,873 metres is reached at the terminal point. The track of the electric road is laid upon metal ties and the entire length of the line will be near twenty miles. The trains will run from St. Gervais to the upper terminus in four hours. There will be a number of stations along the line and the trains will stop at each station in order to let the passengers take a good view of the prospect and also to allow them to become accustomed to the rarefied air as the cars pass up the mountain. It is proposed to make up a train of one electric locomotive and two trailers, which will carry a total of eighty passengers. The terminus of the line will stop short of the top of the mountain, but from Aiguille du Gouter the ascent to the summit can be made in four hours, reaching an altitude of 4,810 metres. It is expected that the Mt. Blanc electric line will be finished and opened for traffic in 1911.

Among the large central stations which have been recently installed in Berlin, we may mention the plant known as the Moabit station, lying in the northwestern part of the town between the Spandau canal and the Hamburg-Lehrter railroad. When fully equipped, the total capacity of the plant will reach some 38,000 horse-power. At present the first part of the plant consists of four direct-coupled groups of 3,500 horse-power each. Another set of generating groups are now in construction, and these will be of nearly double the capacity of the former, being rated at 6,000 horse-power. The groups are made up of triple-expansion horizontal engines which are built by the Sulzer company of Winterthür, Switzerland. Steam is furnished to the engines by thirty-five boilers, each of which has 300 square metres heating surface. These boilers are provided with superheaters and the boiler room contains a set of feed-water heaters. A system of automatic coal delivery to the furnaces is one of the

interesting points of the station. It is well carried out and the whole is operated by electric motors of different sizes. The apparatus gives a delivery of 350 tons of coal to the grates in a ten-hour period. Motors of the Allgemeine Gesellschaft, the well-known Berlin firm, ranging from ten to fifty horse-power, are used in the different operations. The dynamos of the station are mounted directly upon the engine shaft which is driven on either side of the generator by a crank coming from the piston and working at a 1.5-metre stroke. The fields of the generators are seventy-pole, and measure 7.40 metres in diameter. The total weight of the fields is about seventy-five tons. An armature which has about the same weight is employed. It surrounds the field which is mounted on the engine shaft, and its diameter is about 8.60 metres. One of the features of the plant is the extensive switchboard which is erected for handling the machine and the line circuits.

It is reported that an electric railroad is to be constructed in the neighborhood of Rome, which will run between Cosenza and San Giovanni on one hand and between Fiore and Cotorone on the other. The new railroad is to be of the narrow-gauge type. The project includes a plant for the transmission of power to the lines, with the erection of various substations for furnishing the low-tension current. It is promoted by an engineering company at Rome, the Sila Industrial Company, and it has already applied to the government for the necessary concessions and rights for the plant. It is said that the government is favorable to the project and will grant a subsidy so as to assure its proper working. The Ampallino mountain torrent will be used to furnish the power for the lines and it lies not far from San Giovanni. There they expect to secure some 5,500 horse-power from a 700-metre fall.

A novelty in the way of a mercury-vapor lamp is the new form made on the Heræus system which the Poulenc Company brings out. Instead of glass, an envelope of melted quartz is employed and this firm has now succeeded in making quartz tubes and other vessels very successfully. One advantage of the use of quartz for the lamp is that it allows the ultra-violet rays to pass through, which is not the case with glass. One of the new lamps made at Paris is constructed to run on 110 volts and takes from 300 to 400 watts. It is very good for photographic use, seeing that it allows the active part of the spectrum to pass.

Tantalum and carbon filament lamps have been compared in a series of tests recently made by the German physicist Dr. Seidek. The lamps having filaments of these two materials were constructed so as to give about the same normal candle-power, and worked on a voltage of 110. The intensity of the lamps was measured by means of an improved photometer of the Lummer pattern, using voltages which varied from seventy-five to 200 volts. At seventy-five volts, the tantalum lamp showed 6.4 candle-power and the carbon filament only 2.5 candle-power. The rise of candle-power with the voltage is quite different, however, in the two cases, and we find that at 110 volts the curves showing the candle-power now cross and the common value is twenty-five candle-power at this point. At 160 volts, the carbon filament shows 209, while the tantalum only reaches ninety-three candle-power. When 200 volts is reached, the carbon filament burns out, while the tantalum filament remains steady at 206 candle-power. In the tests it is found that the tantalum lamp when burned at 110 volts consumes only 1.06 watts per candle. Fluctuations in the voltage of the circuit seem to have a much less effect on the efficiency and life of the tantalum filament than we find in the case of carbon.

C. L. DURAND.

Paris, September 1.

Extension of Telegraph System in Mexico.

United States Consul Kaiser, of Mazatlan, Mexico, reports that an extensive system of telegraph construction has been decided upon in the state of Mazatlan. The general administration of telegraphs, in concurrence with the office of communications and public works, has ordered the construction of an extensive net of telegraph lines in Lower California, touching every principal city or town of that territory. Further, in view of the good results obtained by the system of wireless telegraphy which has been installed in Cabo Haro and Santa Rosalia, it is resolved to put in new installations in different places on the coast of Lower California in combination with other stations which will be established in Sonora and Sinaloa. Topolobampo has been selected as the site of one of these stations.

A Large Power Company in Yorkshire, England.

The Yorkshire Electric Power Company, of England, has just completed the installation of a large power station at Thornhill, a few miles from Leeds. This company has been authorized to erect three similar stations, from which it will supply power to a large area. This area includes the great Yorkshire coal fields, woolen mills, and many other industrial undertakings. It comprises about 1,800 square miles, contains eighteen boroughs, 118 urban and twenty-one rural districts. The power users in the area which the company will supply include electric railways, textile factories, mines, canals, and manufacturing establishments of many kinds. It is estimated that there is employed at the present time in that district about 3,000,000 horse-power, which is supplied principally by small steam units, and it is hoped that the greater portion of these will be abandoned.

The station just completed is a brick and steel structure. The engine room is 100 feet long and fifty feet wide. The boiler room is seventy feet by eighty feet. The layout is such that additions can be made as becomes necessary; the ultimate equipment of the station will be 60,000 horse-power. The station is favorably situated as regards fuel supply, as this can be obtained either by rail, by water (the station being on a river), or by road. A modern coal-handling plant has been installed, which takes the coal either from the barges or the railway sidings.

The boilers selected are of the Babcock & Wilcox type, each having a heating surface of 5,730 square feet. The generating units are Curtis turbo-alternators, each rated at 2,000 kilowatts. Two of these have been installed, and a third is now in course of erection. The present engine room is large enough to accommodate four of these units.

Power is distributed from the generating station to the substations at 10,000 volts over underground feeders, which are in duplicate. They consist of three-core, paper-insulated, lead-sheathed, steel-armored cables, laid solid in wooden troughs, protected by double boards on the top, the two boards being separated by a layer of sifted earth. At the present time a trunk line has been extended from Thornhill to Pudsey, and there are substations at Thornhill. Three others are being erected. These substations, while differing somewhat, are in general similar. Current is stepped down from 10,000 to 2,000 volts for distribution within a radius of two miles for power purposes, three-phase motors being employed. For lighting, single-phase current is used, the lighting transformers being placed where desired on the secondary mains.

THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

ANNUAL CONVENTION HELD AT LAKE CHAMPLAIN, SEPTEMBER 12, 13 AND 14.

The annual convention of the Association of Edison Illuminating Companies was held at Lake Champlain, N. Y., on September 12, 13 and 14. The meeting was attended by a large number of delegates from the Edison licensee companies throughout the country.

The initial session was called to order by President Joseph B. McCall, of Philadelphia, Pa., in the large parlor of the Champlain Hotel at Bluff Point. The reports of the executive committee and the treasurer were received. Reports were also presented by the following committees:

Meter committee—Alexander Dow, chairman; J. W. Cowles, G. R. Green, A. H. Ackerman, O. J. Bushnell, J. W. Lieb, Jr.

Storage battery committee—L. A. Ferguson, chairman; W. C. L. Eglin, J. W. Lieb, Jr., G. Goettling and W. F. Wells.

Lamp committee—J. W. Lieb, Jr., chairman; C. L. Edgar and S. Insull.

National Code committee—W. C. L. Eglin, chairman; L. A. Ferguson, T. E. Murray.

Steam turbine committee—W. C. L. Eglin, chairman; F. Sargent, J. D. Andrews, C. H. Parker and W. H. Norris.

Electric heating committee—J. L. Gilchrist, chairman; J. D. Israel, A. A. Pope, C. H. Herrick, W. W. Freeman.

Mr. W. T. Morrison read a paper entitled "The Practical Operation of the Nernst Lamp."

Tuesday afternoon was given up to a golf handicap, which was indulged in by a number of the gentlemen present.

In the evening the following papers were read: "The Use of Small-Sized Carbons in Alternating-Current Arc Lamps," G. N. Eastman; "A New Rotative Test Meter," W. J. Mowbray; "Experiences with Tests on All Kinds of Lamps for the Past Year, Including Nernst Lamps," Dr. C. H. Sharp.

On Wednesday morning the following papers were read: "Practical Experience with Steam Turbines," J. A. Radford; "Improvements in Steam Turbines," W. L. R. Emmet; "Methods of Starting up Large Interconnected Systems Quickly after Partial or Total Shutdown," and "Instruction and Training of All Operating and Construction Men Who Work on High-Potential Apparatus and Connections," W. F. Wells; "Relative Advantages of Twenty-five and Sixty Cycles, Seen from the Standpoint of the Central Station Rather than the Power Transmission System Pure and Simple," Philip Torchio and W. C. L. Eglin.

On Wednesday afternoon various forms of entertainment were participated in, and in the evening a paper was presented by Dr. C. P. Steinmetz, entitled "Magnetite Lamps and Mercury Vapor Arc Lamps and Mercury Arc Rectifiers in Connection with Electric Light." Following the discussion on this paper, Mr. J. W. Lieb, Jr., presented an address on "The International Electrical Congress at St. Louis."

On Thursday morning the following papers were presented: "Coal-Handling and Storage of the Edison Illuminating Company at the South Boston Station;" "Notes on Sales of Electric Power," E. W. Lloyd; "The Relation of the Central Station to the Motor-Driven Refrigerating Machine," G. W. Goddard; "The Relative Merits of Discharging Batteries in Edison Systems through Reversible Boosters and through End-Cell Switches," by Gerhard Goettling.

On Wednesday afternoon the attendants visited the Clinton County Fair at Plattsburg. On Thursday they were the guests of Mr. and Mrs. Joseph B. McCall to Ausable Chasm.

The following officers were elected for the ensuing year:

President: Joseph B. McCall, Philadelphia, Pa.

Vice-president: D. L. Huntington, Spokane, Wash.

Treasurer: Alex Dow, Detroit, Mich.

Secretary: G. R. Stetson, New Bedford, Mass.

Assistant-secretary: H. C. Lucas, Philadelphia, Pa.

Officers of Independent Telephone Associations to Meet.

Mr. J. G. Splane, president of the Pittsburg & Allegheny Telephone Company, made the statement, on September 14, that officers of the various independent telephone companies would meet in St. Louis during the present week to go over the result of the inspections and prepare for the ultimate union of their companies, in so far as the long-distance business is concerned. How soon the consolidation would take place he was unable to say.

It is the plan of the independent associations to build connecting links between each part of the systems included in the conference, and it is expected that eventually the Keystone Telephone Company, which is very active in Philadelphia, will join the movement. This would mean a new trunk line between Pittsburg and Philadelphia, going through Johnstown, Harrisburg, Lancaster and other points on the main line of the Pennsylvania Railroad.

The Isolated Midway Islands Cable Station.

The steamship Siberia, carrying Mr. E. H. Harriman, the well-known financier, and party, touched at Midway Islands on its trip to Japan, on August 25. Among the passengers who visited the cable station on the Midway was Mr. L. G. Martin, the cable expert of the Okonite Company, New York, who was en route to Shanghai to superintend the laying of the cables of his company for the Pacific Commercial Cable Company.

Writing from Yokohama to a friend in this city, Mr. Martin interestingly describes his visit as follows:

"I expect you were surprised to get a cable from me from Midway Islands. None of the passengers knew we were to call there until the ship had left Honolulu. I asked for permission to go ashore there and was the only passenger outside of the Harriman party allowed to land. All of the fellows, whom I have known for years, were, as you can imagine, pleased to see me and I was kept busy the two hours we were there answering questions. We took them eight bags of mail, the first they had had since May.

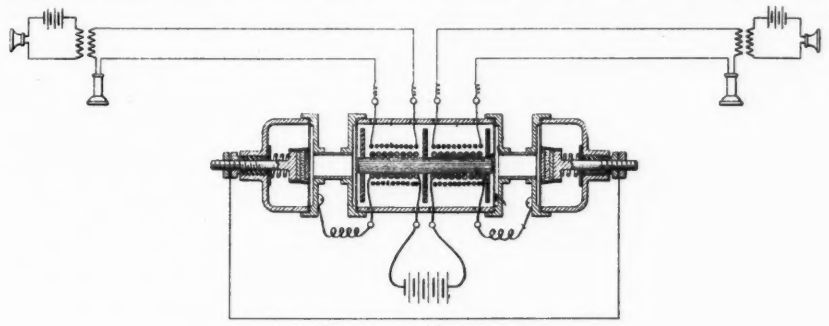
"The islands are nothing but sand heaps and as flat as a pancake, but very healthy. The men have very comfortable quarters and seem fairly well contented I am afraid there will be 'something doing' if ever a hurricane strikes the place."

A copy of the *Siberia Daily News*, dated August 25, and published on shipboard, accompanied Mr. Martin's letter. From this little newspaper, the following interesting item is extracted:

"The Siberia reached Midway Island at 6.45 A. M. to-day. A party of marines and employés of the Pacific Commercial Cable Company visited the ship in order to take delivery of the mails for the island which had been brought from Honolulu. A party of passengers from the Siberia, in three boats, left the Siberia at 8 A. M. for the purpose of visiting the island. Included in the party were the Misses Mary, Cornelia and Carol Harriman, Mrs. Robert Goelet, Mr. E. H. Harriman, Mr. Robert Goelet, Dr. Lyle, Mr. R. P. Schwerin, Captain Smith, Mr. L. G. Martin, Messrs. McKnight, Neill, Frey, and Masters Averell and Roland Harriman. The party was shown through the Cable company's buildings by Superintendent Colley of the Cable company, and returned to the ship at noon."

Electrical Patents.

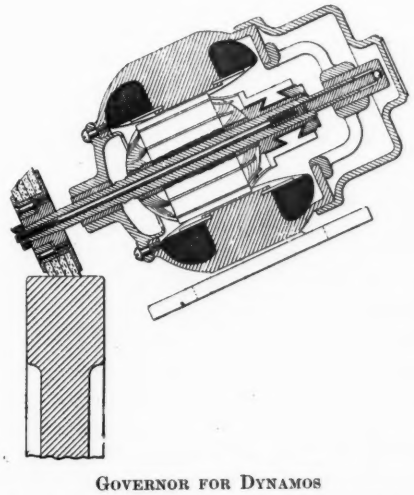
George W. Kretzinger, of Chicago, Ill., has obtained control of a patent recently granted to David H. Wilson, of the same place, on an improved telephone repeater



TELEPHONE REPEATER.

(798,720, September 5, 1905). In carrying out the invention, two telephone instruments are employed, also a repeating device provided with two coils wound upon a common core and having no electrical connection with each other. One coil is connected with one of the telephone instruments, and the other coil is connected to the other instrument. A third coil is wound upon the core, a source of electric supply being in circuit with this last-mentioned coil. A diaphragm is associated with the core. A second diaphragm is opposite thereto and is actuated therefrom, being connected in circuit with the third coil.

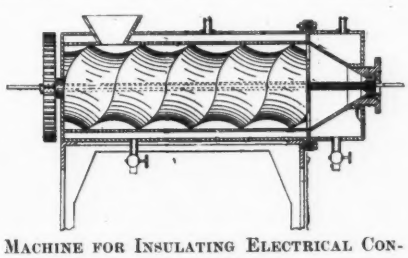
Charles A. Eck, of Newark, N. J., is the inventor of an improvement in governors for dynamos (798,770, September 5, 1905). The invention has more particular reference to a governor adapted to respond to fluctuations in voltage of



GOVERNOR FOR DYNAMOS

the dynamo. The invention contemplates a governor, whose action depends upon the fluctuations of voltage of the dynamo, so that when the voltage increases above a certain point, the governor will act to lessen the speed of the dynamo, and when the voltage decreases below a certain point, the governor will act to increase the speed again. The voltage and the speed of the dynamo thus reciprocate and tend to render both the voltage and speed constant. In carrying out the invention, the dynamo is constructed with a magnetic field and with a rotatable armature shaft carrying an armature and a commutator mounted within the field so as to move longitudinally. The dynamo will be suitably driven by any means found useful for the purpose, but will conveniently receive its motion from the flywheel of an internal-combustion motor through the instrumentality of a friction pulley moving with the armature shaft. Means are provided for positively moving the armature shaft out of its central longitudinal position and the friction pulley into contact with the flywheel. When the voltage increases above a certain point, the magnetic field will act upon the armature shaft so as to move the same into its central longitudinal position and so as to withdraw the friction pulley from the wheel. It will be understood that this movement is a very slight one and that by making the voltage of the dynamo variable it becomes for all practical purposes constant, that is to say, the variation in voltage is so slight as to be hardly noticeable.

A machine for insulating electric conductors is the invention of Charles H.



MACHINE FOR INSULATING ELECTRICAL CONDUCTORS.

Hawkins, of Long Island City, N. Y. (798,606, September 5, 1905). The invention relates to machines for insulating wires used for electrical conductors, and particularly to that class of machines known as the "Royle," the object being to so improve a machine of this class that the insulating material will be forced therefrom in narrow strips. In this machine, a cylindrical casing is provided with a jacket forming an enclosing chamber, a worm being placed in the casing. A supplemental casing is located at one end of the cylindrical casing and is provided with a conical chamber which communicates with the interior of the cylindrical casing. The conical chamber is closed at its apex by a plug having concentrically arranged slots forming openings. A tube is passed longitudinally through the worm and is secured in the plug.

Static Electricity in Ore-Dressing.

The method of separating ores invented by Professor Lucien I. Blake, by static electricity, which depends upon the different conductivities of the constituents of the ore is well known. Professor Blake has now extended the use of static electricity to ore-dressing, taking advantage of the different inductivities of the various constituents. His new system has been described by Mr. W. G. Swart. The ore is dropped from a hopper over a feeding device, and falls between two poles charged oppositely by a static machine. The action of these two poles is to cause the different constituents in the stream of ore to be deflected from the vertical path to different degrees, and they then fall in separate receptacles. The arrangement is exceedingly simple, and yet is said to be positive and to give remarkable results. Mr. Swart refers also in this article to the static machines which have been used in the Blake system. In these all brushes and contacts have been done away with. The revolving plates are of mica, and are run constantly day and night in damp and dusty mills. The machines, however, are enclosed and are supplied with a forced draught of hot, dry air, which not only maintains all parts dry and clean, but removes the ozone as fast as it is formed.—*Engineering and Mining Journal.*

Electricity in Its Application to Everyday Life.

The issue of the Omaha *Bee* for July 30 is designated as an electric number, and contains much interesting and valuable matter concerning "Electricity in Its Practical Application to Our Modern Everyday Life." In addition to the text there are numerous illustrations showing forth some of the most important applications of electricity. A particularly interesting contribution is by Mr. Edward Rosewater, editor of the *Bee,* entitled "Personal Recollections of Some of the World-Famed Electricians."

Reviews of Current Engineering and Scientific Literature.

Some Transmission Troubles from the Far West.

Some of the unusual troubles met by the transmission engineers of the Far West are here referred to by Mr. G. W. Appler. One of the minor difficulties at the power-house at Valta, Cal., was due to leaves and twigs getting into the penstock and clogging up the screens. This was overcome by placing a cylindrical screen over the conduit leading to the penstock. This screen is driven by a small current water-wheel. The water falls into the conduit through the screen, and leaves, caught by it, are thrown to one side. At the Kilarc plant the exciters are provided with impulse wheels and induction motors, the latter being used in case of a breakdown of the small water-wheels. It was intended at first to allow these motors to float on the bus-bars, but this was found to be undesirable, and it is now left to the switchboard attendant to throw them on in case the water-wheels break down. During February, 1904, a severe storm washed out a pole on the transmission line from Valta to Keswick at the point where it spans the Sacramento river. The pole tilted up stream about eighty degrees, breaking off both insulators and allowing the line to come down on the cross-arm. Although the line voltage is 26,000, it was kept in operation under this condition for two hours, until the consumers at the other end could make ready for a shutdown. Repairs were made within three hours. During the same storm the line crossing the Sacramento river at Anderson was washed completely away. To provide a temporary line a circuit was carried up stream five miles to a bridge, where it crossed the river, and there was tapped on to an irrigation circuit constructed for only 2,000 volts. This temporary circuit operated satisfactorily at 20,000 volts for two months of almost continuous rain. On the twenty miles of line from Kilarc to De La Mar a special telephone construction has been adopted to avoid induction troubles. The main power line is transposed every three miles, and the telephone line is carried on the same poles. It is transposed at the same points, and a vertical transposition is accomplished between each pair of poles by zigzagging the two wires up and down on opposite sides of the pole.—*Abstracted from the Electric Journal (Pittsburg), September.*

The Actual Cost of Energy Used in Driving a Small Engineering Works.

Some data are given here concerning the equipment of a small manufacturing establishment in Lancashire, England. The shops have been equipped with motors powerful enough for dealing with a larger volume of work than is at present done. The various classes of tools are grouped together so as to be driven off line shafts as short as possible. All are driven by means of cross belts and countershafts, except two hoists and a ventilating fan, which have each a separate motor. It has been found from records that the average power developed is only about one-eighth of the total power installed. This is due to the fact that only four of the motors are running constantly. The others are started and stopped intermittently as required. The motors vary in size from two and one-half to fourteen and one-half horse-power. There are eleven motors in all, with a total of eighty-two horse-power. The power supply is obtained from the public station at 220 volts. The rate charged is three cents per kilowatt-hour for the first 1,500 units, and two cents per kilowatt-hour thereafter. Five per cent discount is allowed from the bills for prompt payment. The records show that for the three quarters ending, respectively, September 30, 1904; December 31, 1904, and March 31, 1905, the average cost per kilowatt-hour was 2.17, 2.17 and 2.13 cents. The average number of hours worked during the quarters was 563, 577 and 572, making the average cost of energy per hour 19.56, 19.88 and 18.44 cents, respectively. The average power used for the three quarters was 9.15, 9.17 and 8.67 kilowatt-hours, which, allowing 850 watts per brake-horse-power-hour, correspond to 10.74, 10.76 and 10.20 horse-power.—*Abstracted from the Electrical Review (London), September* 1.

Rubber-Growing in Ceylon.

Ceylon, during the past season, shipped 100,000 pounds of rubber, all produced from the island plantations. The shipment was in the form of biscuits of chemically pure rubber, which brought in the market a better price than the finest Para rubber. There are, however, difficulties in producing rubber in this form, since a large drying-room is necessary for spreading out the moulds, and a period of from six days to six weeks is required for drying. It is thought that the Ceylon rubber will in future be shipped mostly in the shredded form, which is as pure as the biscuit rubber, but is less attractive and does not sell as readily. The growing of rubber has been going on for some time in Ceylon, merely as an experiment, until within the past three or four years. Since then 60,000 acres have been planted in Ceylon, and an equal area in the Straits Settlements, at the rate of 250 trees to the acre. The planting has been done in a systematic and scientific way, so that trees reach sufficient maturity to begin producing in three years, in exceptional cases, and in all cases in six years. It is estimated that during the present year 100,000 acres will be added to the rubber plantations in Ceylon, and a similar area in the Straits Settlements, giving the two colonies a total of 320,000 acres, which, at 250 trees to the acre, represents no fewer than 80,000,000 rubber trees under cultivation. This surpasses anything hitherto attempted elsewhere in the world, for the 60,000,000 rubber trees of the Congo districts include the wild trees as well as those under cultivation. It is estimated that in three years, at the present rate, allowing for no extension of the rubber-cultivated area, Ceylon and the Straits Settlements will be in a position to supply with the finest rubber at present known in the world the present demand for rubber of any kind. All the rubber plantations up to the present time are within a belt of fifty miles from the coast, or a maximum of 100 miles by rail from the shipping ports.—*Abstracted from the British Trade Review (London), September* 1.

Note on Some Experiments with Hertz Oscillators.

During the course of some experiments in wireless telegraphy for military purposes by Lieutenant W. L. Evans, it became important to determine the effects produced by different methods of earthing connection of the aerials. For this purpose an oscillator was employed, consisting of a square capacity seventeen feet long on the sides, suspended by means of insulators fourteen feet above the ground. In the centre of this area a vertical wire was led to one knob of a spark-gap, the other being connected by a similar wire to an arrangement of iron-wire netting also seventeen feet square, placed directly below the upper area, and suspended hori-

zontally by insulators two feet above the ground. The two surfaces were thus four feet above the ground. An induction coil was employed in the usual way to set up oscillations of the system. The current flowing in the vertical wire was measured with the lower capacity insulated. It was then connected to the ground by short wires allowed to rest on the earth's surface, and the current of the vertical wire was again measured. Third, the lower capacity was connected to a good telegraph earth, and a third current reading obtained. It was found that the current flowing in the vertical wire in the first case was reduced by fifty-six per cent when the lower capacity area was allowed to touch the ground, and by eighty-five per cent when the area was connected to the earth. By means of a receiving station, carefully syntonized, and of similar design to that of the transmitter, placed about a thousand yards distant from the transmitter, variations in the amounts of the received current were observed which were closely comparable with the variations in the current of the transmitter for the three tests. The conclusion arrived at was that any connection of a transmitter or a receiver of this type with earth was objectionable. The most desirable form for the oscillator was a close approximation to a symmetrical Hertz indicator, as had been advocated by Sir Oliver Lodge.—*Abstracted from the Electrician (London), September 1.*

An Electrically Operated Casting Wagon.

An electrically operated casting wagon having a capacity of twenty tons is now in service at the Burbach Metallurgical Works, Loraine, Germany. It is here described by Dr. Alfred Gradenwitz. This wagon is said to embody a number of improvements over the usual type of electric casting wagon, and in service is found to be free from certain drawbacks. The machine was designed to be wear-resisting under the severe conditions obtaining in a steel works. The lifting is effected by an electric motor through the intermediary of a hydraulic gearing. A slow-running three-plunger pump, operated by a motor, is placed at the back end of the boom, where it serves, in part, as a counterweight, and supplies the hydraulic pressure necessary to lift the boom together with the ladle. The speed of the motor, and hence the performance of the pump, can be controlled at will. The travel of the boom is limited automatically both upward and downward. To produce the rotary motion, the upper rotary part supporting the kettle turns round a column of wrought steel, which is located in a heavy cast-iron truck. A plunger, which is free to rotate around the wrought-iron column, carries at its lower end a strong, rotating, toothed wheel consisting of two parts, and fixed rigidly to the plunger. On this rotary plunger there is arranged the lifting cylinder, which is so located that the stuffing-boxes are entirely free from lateral pressure, the plunger above the column having a rectangular cross-section, with which the cast-iron nave fitted into the wrought-iron beam engages. The rotation of the plunger is produced by a motor installed in the truck, and is transmitted to the transversal beam through a quadrangular piece, thus doing away with any rods or spring, and leaving fixed the readily accessible lower stuffing-box, which does not take part in the rotation. To produce the various motions of lifting, rotating, displacing and tilting, individual motors are employed. This brings simplicity in the arrangement of the driving mechanism, and gives great facility for the control of the complete machine. There are thus four similar independent motors, each rated at fourteen horse-power, so as to make the parts interchangeable. The traveling mechanism of the truck is geared to the rear axle. On account of the high speed, which is from eighty to ninety metres per minute, two motors of forty horse-power each are employed. The ladle has a capacity of twenty tons, a projection of three metres, and a vertical lift of eighty centimetres.—*Abstracted from the Iron Trade Review (Cleveland), September 2.*

New Methods in the Metallurgical Treatment of Copper Ores.

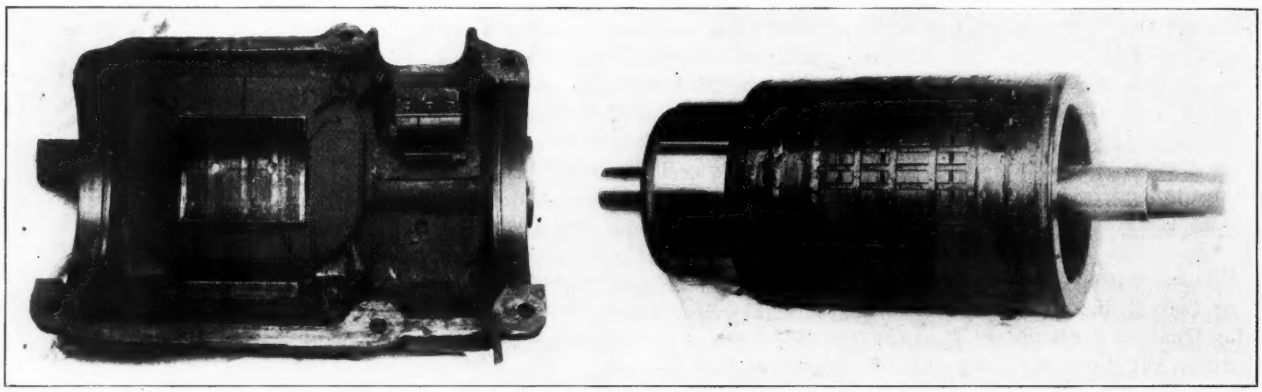
The electrical profession is naturally interested in any developments in the copper industry because of its great dependence upon this valuable and rather expensive metal. In this communication Dr. N. S. Keith describes a method of treating low-grade copper ores—ores which for some time have not been worked because of the lack of a method that would pay. There are vast deposits in the United States, particularly in the eastern section, which carry copper, gold and silver, although the contents of these metals are small as compared with copper ores of the middle and far western states. There are deposits of this character in New York, New Jersey, Pennsylvania, Maryland, Virginia and the Carolinas. Certain of these were worked some years ago, but to-day are neglected. They contain the copper and silver usually in combination with sulphur, and the gold free. The material is of such a character that it does not supply its own flux, hence the usual methods of reduction can not be applied. The method devised to meet these conditions by Dr. Keith consists in grinding and comminuting the ore to a fine state. It is then mixed with about three per cent of pulverized coal. This mixture is introduced at the top of a furnace in which the reduction takes place. The furnace consists of a vertical shaft about twenty feet high, lined with firebrick. At the top are many openings, through which the ore is introduced and flames from producer gas or other similar fuel. The bottom of the interior of the shaft is inclined at an angle of about forty-five degrees, and this incline is extended into the dust-collecting chamber. This chamber, in turn, connects with another vertical shaft also fitted with an inclined bottom dipping toward the other. The interior of this shaft is filled with pieces of coke or small stones, over which water trickles. The draft for this furnace is produced by an exhaust fan through a pipe in the top of the second or condensing shaft. As powdered rock or coal falls down through the first shaft it is intensely heated by the gas flame. The carbon is first burned to carbon dioxide, then a little later, due to the excess of carbon and deficiency of oxygen, this is reduced to carbon monoxide. At the same time the copper and silver sulphides are oxidized. These later on in their journey, coming in contact with the carbon monoxide, are reduced to metallic copper and silver at a temperature which fuses them, so that they collect as small globules of metal in the dust chamber. Any metallic particles which may be carried through the second shaft are met by the water and carried back to the dust chamber. From here the material, as it collects, is carried off by the stream of water to concentrators, where the metal is separated from the sand in the usual way. Dr. Keith says that the process is cheap, as under the economic conditions of the localities considered, the cost does not exceed one dollar per ton on a scale of treatment of 100 to 200 tons per day of twenty-four hours. This should leave a satisfactory profit, since in many of these deposits the copper constituent alone averages from twenty to sixty pounds per ton of rock.—*Abstracted from the Journal of the Franklin Institute (Philadelphia), August.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Line of Railway Motors.

Heavier rolling stock and faster schedules in electric traction have from time to time necessitated the production of larger motors for elevated, subway, interurban and suburban service. Each increase in size has been marked by mechanical changes. The Westinghouse Electric and Manufacturing Company has embodied in a new line of railway motors wide departures and great improvements, which is fully described in this article. The smallest motor of the new design has a capacity of seventy-five horse-power and the largest 200 horse-power, with a number of sizes between the two.



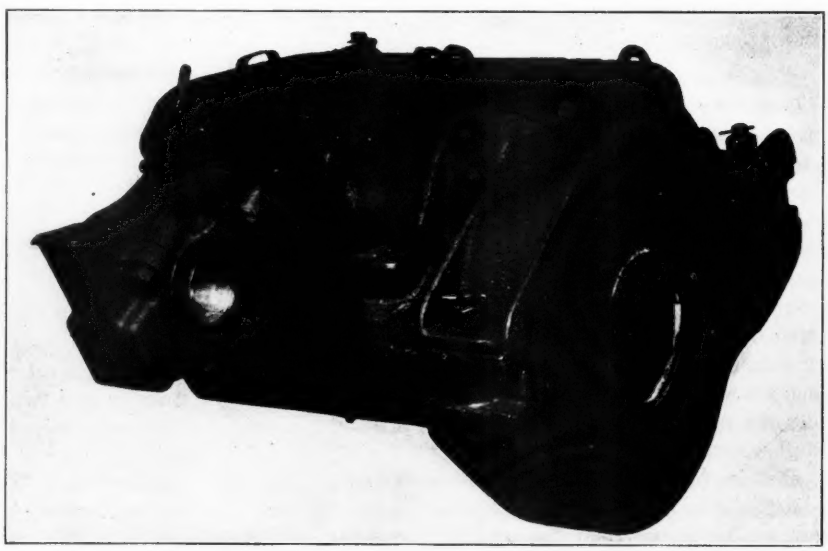
ONE-HALF OF FIELD AND FRAME AND ARMATURE OF NEW TYPE RAILWAY MOTOR.

Among the many features which characterize these motors may be mentioned the diagonally divided field frame which makes every part accessible; the gear case supported entirely at the ends, so as to avoid the side strains which have been the source of so much trouble; housings for armature bearings clamped between the two halves of the frame; generously proportioned bearings with one of the most effective systems of lubrication yet devised; armature and commutator assembled upon a single spider; bar-wound armature with split coils; commutators with many bars; low current density in the brushes; bolted-in laminated poles; sealed field coils wound with strap; excellent commutation; high efficiency; low operating temperature and great mechanical strength.

Limitations are naturally placed on the size and construction of a motor by the amount of available space on the truck of the car; therefore the frame of square cross-section has been adopted as utilizing this space most advantageously. All motors in this line have cast-steel frames split at an angle of forty-five degrees with the horizontal. The axle bearings are carried by the lower half of the field frame and are divided at an angle of thirty-five degrees with the perpendicular, so that the weight of the motor is supported almost entirely by the part of the frame extending over the axle rather than by the axle cap bolts. By lifting off the upper half of the field casting the armature may be removed from the frame without taking the motor from the truck; or the motor may be removed from the truck by simply taking off the gear case and axle caps. Three bales conveniently located make handling of the motor easy. Bolts with nuts and lock washers hold the two halves of the frame together and the axle caps in proper position.

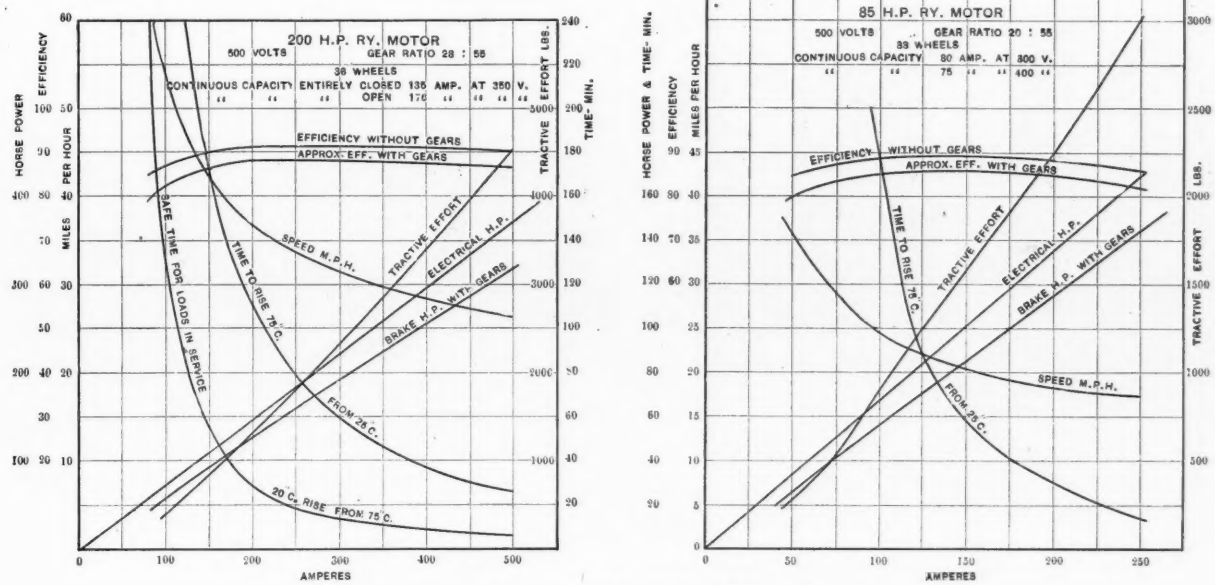
Housings for the armature bearings are circular in form and are turned slightly larger in diameter than their seats in the frames so that, when clamped in place, all the advantages of a press fit are obtained. Finished shoulders on the housings prevent any lateral movement and also take the entire end thrust of the armature instead of imposing this severe strain on the clamping bolts. Two bolts through the frame at each end prevent the housing from turning.

The armature bearings are made of solid phosphor-bronze bushings finished all over, with a three-thirty-second-inch lining of babbitt metal. If from neglect the bearing should become so hot as to melt the babbitt the armature would be supported on the brass shell and would not strike the poles. Both oil and waste lubrication are provided. The waste



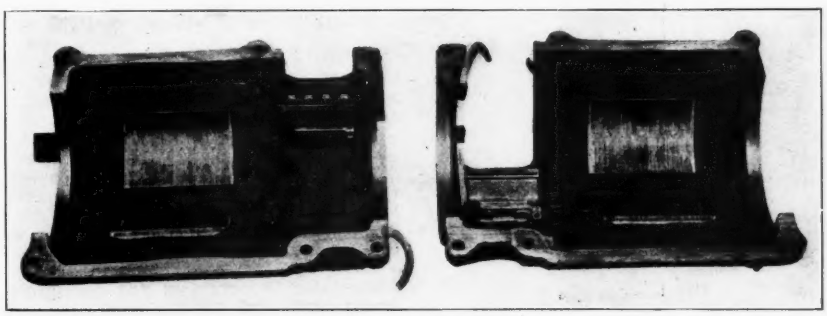
SEVENTY-FIVE-HORSE-POWER RAILWAY MOTOR, WITH GEAR CASING.

comes in contact with the bearings on the low pressure side and is supplied with oil from separate pockets from below; in this way it is filtered before reaching the bearing. The amount of oil in the reservoirs may be gauged so that it may be kept at the proper level for economical service. With intelligent care these bearings will run 100,000 to 150,000 miles. The axle bearings are similar in construction to those of the commutator, except that split bushings are used. Here also lubrication is by means of oil and waste, the oil being supplied from below. This is the same method which has given such universal satisfaction in steam railway service. All bearings have generous



PERFORMANCE CURVES OF NEW HEAVY RAILWAY MOTORS.

punchings keyed on a cast-steel spider which also carries the commutator. The shaft is forced into the finished armature and keyed thereto and may be removed, should necessity arise, without disturbing the windings or commutator. The armature coils are strap wound and made in two parts. As the top coils are more liable to injury this design makes it possible to remove the damaged part without disturbing any other part of the winding. The coils are liberally insulated with mica, and sealed and further insulated by dipping in varnishes which are oil-proof and moisture-repelling. On each end the armature slots are made deeper and wider, thereby providing space for mica cells, which greatly reenforce the insulation at these points. As a further protection fibre strips are taped to the upper sides of the top coils. A bell-shaped flange at the pinion end and a cylindrical flange on the commutator end form rigid supports for the windings. Countersunk bands of steel wire on the core hold the coils firm and secure. Openings through the spider and core allow a free passage of air, which is thrown forcibly against the field coils, thus maintaining a low temperature throughout the motor.



INTERIOR CONSTRUCTION OF 200-HORSE-POWER RAILWAY MOTOR.

dimensions and the large surfaces readily dissipate the frictional heat and ensure cool running.

Pole-pieces, built up of punchings of soft steel, are bolted to the top, bottom and sides of the motor frame, which, being almost square in cross-section, permits the use of flat field coils. These coils are wound of copper strap insulated between turns with treated asbestos rib-

The commutators are made from a great number of hard-drawn copper bars with short necks, carefully insulated from each other and held securely between insulated V-rings. A liberal wearing depth ensures long life.

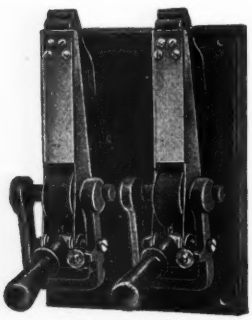
The brush-holders are of the sliding type with springs of phosphor-bronze held in a harness which definitely fixes the radius of action of the spring tip and is so constructed as to practically eliminate friction between turns, making it possible to provide a large number of turns, which gives a very uniform pressure upon the brush over a considerable range without requiring adjustment. The tension of the spring may be adjusted without removing the holder from the motor. The brush-holder proper is bolted to an insulated guide and may be removed without disturbing the insulation or connections. Leads of flame-proof, flexible, rubber-covered cable are brought out at the front of the motor over the commutator through insulating bushings. Access to the brushes and brush-holders is provided through a large opening in the frame over the commutator which extends well down the side, making inspection easy from the pit. A hole in the rear end bell and an opening under the commutator provide means for inspecting the clearance between the armature and field-poles.

Pinions used on these motors are machined from solid steel forgings and held on tapered seats by keys, nuts and lock washers. Gear cases are made of malleable iron and divided along the centre line of armature and axle.

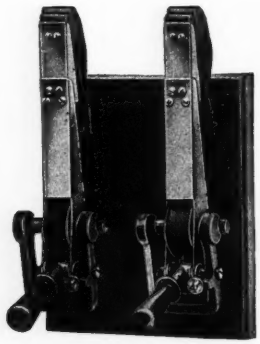
New Forms of Circuit-Breakers.

The S. E. circuit-breaker is the result of a successful attempt to reduce automatic carbon-break circuit-breakers to their simplest possible form.

All automatic circuit-breaking devices, irrespective of the particular duty which they are to perform, must consist of at least two parts: first, a contact making and breaking member and secondly a member which will actuate this member on an overload.



OVERLOAD RELEASE, DOUBLE-POLE, 125-250-VOLT CIRCUIT-BREAKER.



OVERLOAD RELEASE, DOUBLE-POLE, 500-750-VOLT CIRCUIT-BREAKER.

OVERLOAD RELEASE, SINGLE-POLE, 125-250-VOLT CIRCUIT-BREAKER.

In the S. E. circuit-breaker the first mentioned member consists of a light U-shaped moving arm and a stationary laminated brush. The second member consists of a resilient coil, one end of which is mechanically and electrically fastened to the light moving arm and the other end to the base. A U-shaped armature surrounds this coil and a magnetic core goes through its centre. The addition of a handle with a roller completes the circuit-breaker.

The moving part being light and substantial does away with excessive strains on opening. All small catches and delicate adjustments are absent and the whole construction is rugged and not liable to give trouble in constant service or under severe treatment.

These breakers are especially adapted for use in places where they may be handled roughly by ignorant or unskilled operators. A movement of the handle downward closes the breaker and upward opens it.

The same type is used in all sizes up to 10,000 amperes and is also made in three and four-pole combinations and with no voltage, underload, shunt trip and reverse current releases. The illustrations shown are characteristic for all sizes.

These circuit-breakers are made by the Switchboard Equipment Company, Pittsburg, Pa.

Locomotive Testing Plant at the Louisiana Purchase Exposition, St. Louis, Mo.

At the meeting of the advisory committee held at Broad street station, Philadelphia, June 12, 1905, the following preamble and resolutions were presented by the secretary and unanimously adopted:

THAT WHEREAS, The advisory committee, representing various scientific and technical interests in the tests of locomotives at the Louisiana Purchase Exposition, having completed its formal work, and desiring to express its appreciation of the action of the Pennsylvania Railroad system in conceiving, planning and executing these tests, now makes of record the fact, that:

The Pennsylvania Railroad system has brought into existence an entirely new testing plant designed for mounting either freight or passenger locomotives, and capable of absorbing for an indefinite period the maximum power of a modern locomotive when running at any rate of speed between ten and seventy-five miles per hour;

OVERLOAD RELEASE, SINGLE-POLE, 500-750-VOLT CIRCUIT BREAKER.

It has caused to be designed and constructed a dynamometer capable of registering the tractive power of the heaviest locomotives, and at the same time so sensitive as to indicate the slightest variation in the force it may exert;

It has purchased and standardized instruments and apparatus for use in securing all data which have been deemed to be of scientific interest;

It has organized a complete corps of observers, engineers and computers to carry out the tests, and to record, tabulate and analyze the results;

It has invited and secured the cooperation of scientific and technical men of this and other countries to assist it in placing the tests upon the highest scientific plane possible in such work;

It has overcome difficulties, in many cases perplexing and serious, incident to the carrying out of such a work as a part of a great international exposition;

It has, as a result of its effort, defined the action of seven different typical locomotives as regards the performance of the boiler, the engine, and of the locomotive as a whole, under many different conditions of operation, making a record of a mass of information concerning the economic performance of the modern locomotive of great immediate value, and supplying a basis of comparison which will prove useful for many years to come;

It has met the expenses of equipping and operating the plant with an unstinted hand, always holding considerations of cost subordinate to the definite object of making the tests as complete and valuable as possible, notwithstanding the fact that the amounts involved have been far greater than have ever been appropriated to any similar undertaking; and

It has undertaken a broad plan of publication which is to result in making all its data derived from tests, and all conclusions based thereon, together with a description of methods and means employed, all in great detail, accessible to railroad officials and locomotive designers throughout the world; therefore, be it

Resolved, That the advisory committee expresses its appreciation of the part taken by the organized staff concerned in conducting this work;

It recognizes that special credit is due to Mr. J. J. Turner, third vice-president, and Mr. Theo. N. Ely, chief of motive power, for their efforts in securing the interest and the favorable action of the Pennsylvania Railroad system in behalf of the proposed work, for the broad views which have prompted them in giving it their general direction, and for the interest they have shown in the maintenance of the high standards which have marked its progress;

To Mr. F. D. Casanave, for the able manner in which he has effected a working organization, for his successful efforts in securing the locomotives to be tested, for the skill, earnestness and freedom from friction with which he has managed the entire work;

To Mr. A. W. Gibbs, for his enthusiastic personal support, and for the fulness with which he has made available the resources of the motive power department;

To Mr. A. S. Vogt, for a design of testing plant of unusual beauty and perfection of details, and of such excellence in operation that under the severe conditions of service, interruptions were more frequently due to locomotive defects than to difficulties with the plant;

To Mr. E. D. Nelson, for the efficiency with which he organized and managed the expert staff, and for the ability shown in dealing with all scientific questions involved;

To Mr. G. L. Wall and his efficient staff of assistants for the devotion shown in the operation of the plant, their ability and determination in overcoming difficulties, their skill in maintaining running conditions, and their painstaking efforts in securing accuracy in results.

Signed:

W. F. M. GOSS, F. H. CLARK,
H. H. VAUGHAN, C. H. QUEREAU,
J. E. SAGUE, H. V. WILLE,
E. M. HERR, W. A. SMITH.

Advisory committee.

Steel Frame Multipolar Belted Motors.

The accompanying illustrations show a new line of steel frame multipolar belted motors placed on the market by the Triumph Electric Company, Cincinnati, Ohio. These steel frame motors have been designed with a view to supplying the demand for a strong, light-weight machine of high efficiency and good wearing qualities. The manufacturer states that the construction of the Triumph machines is of the highest grade material throughout. The steel frame motors have met with well-deserved favor. The motors are made either shunt, series or compound wound, according to the service for which they are intended. They are adapted equally well to operate line shafts, machine tools, printing presses, laundry machinery, cranes, hoists, elevators, pumps, fans, or any other sort of apparatus.

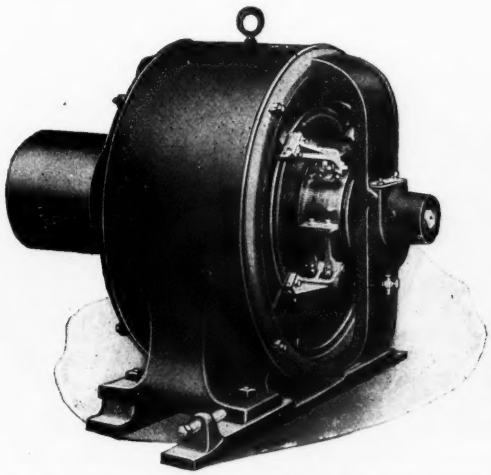


FIG. 1.—TWENTY-HORSE-POWER STEEL-FRAME MOTOR.

FIG. 2.—FRAME AND FIELDS.

The frame is made of close-grained steel, making a small and compact machine. The brackets are centered against the crown, and firmly held by steel bolts. These brackets can be readily removed to allow easy access to fields and armature. The poles are also of steel, equipped with a special design of laminated tip or shoe to provide the necessary magnetic fringe and eliminate sparking at the brushes. This construction also produces cool running and raises the efficiency of the machine.

The bearings are made of a specially prepared bearing metal, and are of the self-oiling and self-aligning type. They are made to standard gauge and reamed so as to be interchangeable and easily replaced. Oil wells of ample capacity are provided in each pedestal. Fig. 1 shows a twenty-horse-power steel frame motor, and Fig. 2 the frame and fields.

The armature is of the iron-clad, laminated-core, tooth type. The thin laminated discs which make up the core are annealed and japanned after punching to prevent eddy currents, and are then mounted and keyed directly on the armature shaft. When so mounted they form slots on their outer circumference, into which the armature coils or windings are placed, and thus thoroughly protected from mechanical injury. The armature coils are form-wound, and each consists of a continuous length of copper with no joint except where connected to the commutator. Each coil is thoroughly insulated and tested before being placed in position, and additional insulation is provided in the slots by alternate layers of heavy fuller board, mica and oiled linen.

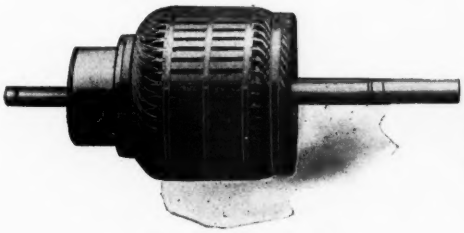


FIG. 3.—ARMATURE.

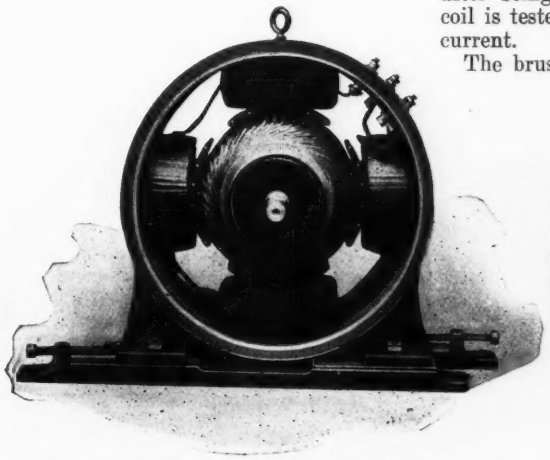


FIG. 4.—FRAME, SHOWING ARMATURE IN POSITION.

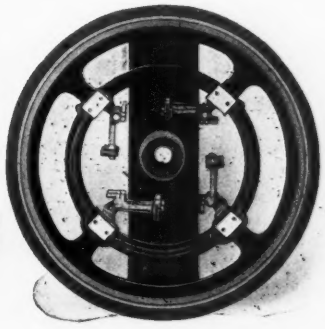


FIG. 5.—FRONT BRACKET AND BRUSH RIGGING.

The commutator is made of segments of hard-drawn or of drop-forged copper. After having been in use for a short while the commutator takes on a blue-black polish. The bars are of great depth, so as to be of ample size even after years of constant use. They are mounted upon a cast-steel shell of such construction that it is impossible for the bars to move or the commutator to get out of true. The bars are insulated from this shell and from one another with the best mica. Fig. 3 shows the armature, and Fig. 4 the frame with the armature in position.

With a view to making the machine as compact as possible, both ends of the armature are so arranged that the pedestals may project under them. At the same time the new improved oil guard makes it impossible for any oil from the bearings to enter the armature or commutator.

The field coils are either shunt, series or compound wound. They are form-wound, thoroughly baked and insulated with fuller board, mica, canvas and insulating varnish. During construction, and after being placed in the machine, each coil is tested with 2,000 volts alternating current.

The brush-holders are of a simple, effective design. The brushes are of the best quality carbon, rigidly attached to the holder, the proper adjustment being secured by a tension spring.

The entire brush rigging is carried from the front end of the crown, so that no oil can reach the brush-holders. The brush-holders are convenient of access, and the yoke, when properly set, is held in position by a lock screw. Fig. 5 shows the front bracket and brush rigging.

A New Galvanometer.

The Leeds & Northrup Company, of Philadelphia, Pa., has recently placed upon the market a new form of high sensibility D'Arsonval galvanometer for cable testing, shown in the accompanying illustration.

In design it is a radical departure from the old style laminating magnet with suspension tube that allowed but small clearness for the coil and did not permit the suspended system to be visible.

This improved design possesses the following prominent features:

The removal of the tube containing the moving system is readily effected by the loosening of two thumb screws.

New Type Galvanometer.

If any adjustments are to be made, such as the insertion of a new suspension, the tube can be removed from the magnet and laid horizontally on a table, which is often of great convenience.

The tube has at its back a simple device for clamping the coil, so that the galvanometer and tube may be moved about.

The coil suspension has a spring device in the top of the tube so that the suspension is not easily broken.

The entire system is visible by means of the open glass front given to the tube. A small index-point on the coil shows when the galvanometer is exactly level and the coil is swinging centrally in the field.

The coil is of the rectangular type, similar to the Leeds & Northrup type H coil, but is made smaller, so that the system will be lighter and give a greater sensibility with a given period of swing.

To provide the highest possible insulation the entire galvanometer is insulated from earth by means of three hard rubber leveling screws terminating in steel points. The bottom of the leveling screws have deep grooves turned in them, thus making a "petticoat" insulation.

The Protected Third Rail of the New York Central Railroad.

Plans have been made for the installation of a system of protected third rail for the electrification of the New York Central & Hudson River Railroad. The arrangement consists of seventy-pound section bull-head rail suspended at eleven-foot intervals by two-part insulators, which are locked in position by means of bolt-end straps. The parts are supported by cast-iron brackets, which are attached to extended cross-ties by means of lag-screws. Between the insulators the rail is covered upon the top and sides with painted, well-seasoned, long-leaf yellow pine. The rail is supported loosely in the insulators, and is allowed a slight movement in the sheathing, so that the suspension is flexible and adjusts itself to the inequalities in the roadbed. The rails are bonded between insulators, copper bonds being attached on both sides of the lower head, the sheathing being notched to accommodate the expansion loop. The contact shoes are of the same type as for top contact rails, except that the springs are arranged to draw the shoe up instead of down.

A New Unipolar Dynamo.

A German patent issued to Mr. A. Beringer for a new unipolar dynamo is noted in the *Electrical Review* (London), September 1. This machine consists of an annular channel with insulated sides, situated between the circular poles of a magnet. This channel contains a conducting fluid, which is set in rapid motion by the direct impact of steam through a set of nozzles. In contact with the top and bottom of this rotating fluid are two conductors which serve for collecting the current.

Canadian Independent Telephone Companies.

Independent telephone companies representing Ontario, Quebec and New Brunswick met in convention in Toronto on September 6, and formed the Canadian Independent Telephone Association. Resolutions were adopted declaring in favor of government ownership of all trunk lines, to which all companies should have access, and protesting against exclusive rights to put telephones in railway stations granted to any one company. A constitution was adopted, setting forth the name of the organization as above.

Mr. B. G. Hubbell, of Buffalo, addressed the convention. He referred to the growth of the independent companies in the United States, where, he stated, there are now almost 7,000 independent companies, with a capital of $200,000,000. Barely twenty-two of these concerns had failed to perform their contracts.

The election of officers resulted as follows: president, A. Hoover, Green River; vice-president, F. D. MacKay, Peterboro; secretary and treasurer, B. F. Wilson, Markham.

Motor Vehicles to Replace Fifth Avenue Stages in New York City.

The Fifth Avenue Coach Company has placed on trial for the Fifth avenue service in New York city a gasoline electric motor omnibus running on a regular schedule between Washington Square and Eighty-eighth street. This is the latest of a series of experiments which the company has been conducting for several years to obtain a satisfactory motor omnibus for its stage routes. The apparatus has been designed and equipped by the General Electric Company, and if the vehicle is found adequate for the needs of the route, horse operation will be entirely discontinued.

The Chicago & Northwestern Railway is receiving for the "Overland Limited," the fast three-day train to the coast, new equipment from the builders. One of the features of these new cars is the new sleeping arrangements, being of the latest design, maximum size, electric-lighted Pullmans. The cars are fitted with ten sections, a drawing room, and two private compartments in each car. They are intended for the Chicago-San Francisco service. Similar sleeping cars equipped with twelve sections, one drawing room and one compartment, will be operated on the Chicago-Portland line. These sleeping cars, together with dining cars and composite buffet-smoking, library and observation car, constitute the equipment of the train.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MEXICAN POWER COMPANY INCREASES ITS CAPITAL—The Mexican Light and Power Company will increase its capital from $12,000,000 to $16,000,000, to permit important extensions to be made.

NEW ELECTRIC RAILROAD FOR LONG ISLAND—The Manhattan & Long Island Railroad Company, of New York, has been incorporated with a capital of $10,000,000 to operate an electric road eighty miles long in Greater New York and on Long Island, the termini to be in Long Island City and Northport.

FOR CHICAGO MUNICIPAL TRACTION, $26,500,000—Mr. Bion J. Arnold has submitted estimates on the cost of the proposed municipal contract street railway system to the members of the local transportation committee. Mr. Arnold estimates that the cost of the independent system, with overhead trolleys down-town and elsewhere, will be $25,260,000, which is practically the Dupont estimate. He recommends to the committee, however, a heavier rail and concrete beam construction, which will bring the total to approximately $26,500,000.

TENNESSEE POWER PLANT—The plans for the lock and dam and the power plant near Chattanooga, to be erected at Hale's bar, in the Tennessee river, at a cost of over $3,000,000, are now ready for the inspection of contractors at the United States engineer's office. The dam will be of stone and concrete, sixty-two feet high and 2,200 feet long. There will be forty-two turbine wheels in all, each of which will have a capacity of 2,250 kilowatts. The plans for the first time call for the placing of three turbine wheels on each shaft. At the power plant at Niagara Falls there are two on each shaft.

BIG POWER PLANT FOR GREEN RIVER, UTAH—One of the largest power companies in the country is now being planned for Utah. Application has been made to the state engineer for 2,450 second feet of water from the Green river in Grand County, Utah. The applicant declares that he wishes to install five pairs of water-wheels of the Dayton Globe Iron Works pattern, which are to work under a head of ninety to 120 feet, and are capable of developing 36,000 horse-power. According to the application the power developed will be used for electrolytic copper refining, electric lighting and to furnish electric energy for the running of machinery in Salt Lake valley and at Park City.

THE BUFFALO-ROCHESTER TROLLEY LINE—Work is soon to be started on the Buffalo, Batavia & Rochester Electric Railway Company's eastern extension from Williamsville, Erie County, in the direction of Rochester, N. Y. The company was incorporated on October 3, 1904, with a capital of $3,500,000, to construct and operate a street surface electric road from Williamsville to Rochester. The Buffalo, Batavia & Rochester Electric Railway Company is an outgrowth of the Buffalo & Williamsville Electric Railway Company. The Buffalo-Williamsville line was originally constructed from Buffalo to Williamsville, and was four and one-half miles long. The new portion of the road will be constructed on private ground all the way from Williamsville to Rochester, except where it passes through villages, where the tracks will be in the streets.

OHIO AND WEST VIRGINIA TRACTION COMPANIES MERGED—A consolidation of street railway, electric lighting and other interests, valued at between $3,000,000 and $4,000,000, is about to be effected. The properties to be taken over are the East Liverpool & Wellsville Street Railway and its branches, the East Liverpool & Rock Springs Street Railway, the lighting and power-houses of the United Power Company, of Wellsville and East Liverpool, and the East Liverpool Bridge Company. Ordinances have passed first reading in both councils, giving rights of way for a double-track railway over the principal streets in East Liverpool and Wellsville, Ohio. It is proposed to rebuild practically the entire main line, making it double-track for the entire distance, and forming a part of the system ultimately to connect Pittsburg, Pa., and Wheeling, W. Va.

TO PARALLEL AUBURN DIVISION OF THE NEW YORK CENTRAL RAILROAD—A movement to consolidate all of the trolley lines that parallel the Auburn branch of the New York Central Railroad between Syracuse and Rochester, N. Y., is now under way. It is possible at present to go all the way from Syracuse to Rochester by trolley, except between Seneca Falls and Auburn, a distance of about fifteen miles. The total distance between Syracuse and Rochester by way of the Auburn branch is 103 miles. In that area there are three trolley companies now operating. The Rochester & Eastern has a total main line length of forty-four miles, the Geneva, Waterloo, Seneca Falls & Cayuga Lake Park system has seventeen and three-quarters miles; the Auburn & Syracuse system has thirty-seven and three-quarters miles—an aggregate of about ninety-nine and one-half miles.

PROCEEDINGS AGAINST THE CHICAGO TELEPHONE COMPANY—*Quo warranto* proceedings have been instituted against the Chicago Telephone Company, charges being made that the corporation has violated its franchise and the ordinances under which it is operated by making excessive rates to a certain class of subscribers. The company is asked to show by what right it charges $175 a year for business telephones, when by an ordinance passed in 1899 this rate is fixed at $125 a year. The charges also allege that the corporation makes an additional charge or toll to subscribers some distance from the city hall, but within the city limits. President A. D. Wheeler, of the Chicago Telephone Company, has announced that the company's attorneys have cooperated with the lawyers for the prosecution, and made it possible for the city to take the case before the Supreme Court at the October term. The company is thoroughly satisfied with the opportunity to bring about a definite issue on the questions involved in the misunderstanding between the city and the company.

LEGAL NOTES.

TESLA SPLIT-PHASE MOTOR—An order for an injunction was filed in the United States Circuit Court, Southern District of Illinois, on August 3, in the Tesla split-phase motor suit, in which the Westinghouse Electric and Manufacturing Company is complainant, the Diamond Meter Company being the defendant. Patents Nos. 511,559 and 511,560 are involved.

TWO IMPORTANT STREET RAILWAY DECISIONS—Quite recently two important cases were decided in favor of the Schenectady Railway Company, bringing out legal points of importance to the patrons of trolley lines. In the case of Moran *versus* Schenectady Railway Company, in which the wife sought to recover damages for the death of her husband, the evidence showed that Moran had been struck by a car following the one from which he had been ejected. The decision was upon the point that the law grants the servants of a common carrier the privilege of maintaining order on the cars, and ejecting any person at a regular stopping point who refuses to pay fare or who becomes a nuisance. The other case was of a motorman who was injured in a head-on collision for which he was to blame because he disobeyed orders.

OBITUARY NOTICE.

MR. WILLIAM F. FOX, superintendent of the long-distance service of the Northwestern Telephone Exchange Company, died on the evening of September 11, at his home in Minneapolis, Minn. Mr. Fox had been in the telephone service for several years, previous to which time he was chief despatcher of the Minneapolis & St. Louis Railway. He is survived by his wife.

TELEPHONE AND TELEGRAPH.

PETERBORO, ONT.—A telephone line has been installed connecting Peterboro and Buckhorn.

CALVERT, MD.—The Farmers' Telephone Company is building a line from Rising Sun to Calvert.

EAST VARICK, N. Y.—The Bell Telephone Company is to erect a line from East Varick to Romulus.

TROY, N. Y.—The Granville Telephone Company has been purchased by the Bell Telephone Company.

SOUTH PARIS, ME.—The Albany Telephone Company has completed its line from Bethel to North Waterford.

SEAFORD, DEL.—The Diamond State Telephone Company's line from Seaford to Woodland has been completed.

NORFOLK, VA.—The Postal Telegraph-Cable Company has completed the equipment of its new offices in Norfolk.

FORT HUNTER, N. Y.—The Glen Telephone Company is stringing additional wires from its Tribe Hill office to Fort Hunter.

HAZLETON, PA.—The Consolidated Telephone Company has ordered a modern switchboard for its new Hazleton exchange.

KINGSTON, N. Y.—The central offices of the Citizens' Standard Telephone Company will be united and a building erected near the centre of the city.

OTTAWA, CANADA—A new long-distance telephone line has recently been completed by the Bell Telephone Company from Toronto to Collingwood.

SPRINGFIELD, MASS.—The New England Telegraph and Telephone Company will shortly construct a new exchange in Springfield to cost $200,000.

HENDERSON, KY.—J. C. Monteith, representing E. L. Barber & Company, has purchased 201 shares of the Henderson Telephone and Telegraph Company at the par value of $50.

FERNDALE, WASH.—At a recent meeting twenty citizens decided to form an organization for the purpose of constructing a telephone line to Bellingham, at a cost of about $500.

SUPERIOR, WIS.—The Douglas County Telephone Company is making extensive improvements to its east end lines. A central energy system is being installed and several lines of cables are being laid.

NORFOLK, VA.—It has been announced that work on the new Southern Bell Telephone building, which is projected to extend from Williams street to Plume street, occupying the company's present property, will begin about October 1.

CAPE MAY, N. J.—The Cape May city council, at its regular meeting, passed an ordinance requiring the Delaware & Atlantic Telephone and Telegraph Company to place its wires underground, at least 2,000 feet to be buried within a year.

PROVIDENCE, R. I.—The process of "cutting over" the Union lines of the Providence Telephone Company has been completed, and the old switchboard discarded. The new board has been installed in the building erected for this service. The change cost more than $110,000.

MANHATTAN, KAN.—The new telephone line, which will be known as the Manhattan-Kaw Valley line, has Chauncey Bills for president; M. C. Sargent, secretary, and W. R. Yenawine, treasurer. The line is about fourteen miles long, and goes up on the south side of the Kansas river.

MONTREAL, QUEBEC—Among the new telephone offices recently opened by the Bell Telephone Company, and with which connection can now be had, are Piedmont, St. Thecle, Woodlands and Lake St. Joseph. The company has lately completed a new metallic line between Montreal and St. Jerome.

ST. JOHN'S, NEWFOUNDLAND—The new cable laid by the Commercial Cable Company between Canso, Nova Scotia, and Port au Basques, New Foundland, for the New Foundland government has been inaugurated successfully. Messages were exchanged between Premier Bond, in London, and the colonial cabinet.

BRISTOL, TENN.—The Holston Valley Telephone Company has been organized at Holston Valley with the following officers: David McConnell, president; J. D. Thomas, vice-president; Philip Painter, secretary and treasurer. The purpose of the company is to construct a telephone line connecting Holston Valley and the King's mill section of Virginia with Bristol.

GREEN BAY, WIS.—Articles have been filed for the consolidation of the Valley Telephone and Telegraph Company, of Green Bay, and the Valley Telephone Company, of Appleton, under the name of the Fox River Valley Telephone and Telegraph Company. The capital stock is placed at $350,000. Dr. W. E. Fairfield, of Green Bay, is named as president of the new company, and J. P. Hoeffel as secretary. The company will operate in Green Bay, De Pere, Kaukauna and Appleton.

UNIONTOWN, PA.—The Tri-State Telephone Company has rented offices in Brownsville, and will soon extend its county service from Uniontown and other parts of the county to Brownsville and other towns in the Monongahela valley. Connection will be made at West Brownsville with the Union Telephone Company, of California, Pa., which will give service at California, Coal Centre and other lower river towns. The Tri-State has twelve exchanges in Fayette County and about 3,000 subscribers.

DUBUQUE, IOWA—The annual meeting of the stockholders of the Interstate Telephone Company was held recently, and resulted in the election of the following officers and directors: president, G. Harwood, Epworth; vice-president, R. W. Gadsden, Dyersville; treasurer, C. M. Laxson, Earlville; secretary, J. H. Denkhoff, Dyersville; directors, J. M. Dunn, Earlville; J. J. Kann, Elkader, and Vic Stevens, Dubuque. Matters, relative to extensive improvement of the entire system, were discussed and plans for the work, which will be begun soon, were outlined.

SYRACUSE, N. Y.—The new semi-annual directory of the Central New York Telephone and Telegraph Company shows that the company's Canastota exchange now numbers 170 telephones, as compared with 112 enrolled in the directory issued in January last. While this increase is in part accounted for by the fact that the telephones of the Farmers' lines, numbering thirty-four, were taken into the exchange in March, the increase, exclusive of the Farmers' telephones, is considerably greater than the gain made in any six months heretofore.

GRAND RAPIDS, MICH.—In accordance with the instructions of the stockholders at their meeting held last month the directors of the Citizens' Telephone Company voted unanimously to increase the capital stock from $2,000,000 to $3,000,000. A portion of the added capitalization will be placed on sale and the proceeds used for immediate betterments and extensions. In the last fiscal year the company made an increase of 4,000 telephones. The old officers were reelected as follows: president, C. F. Rood; vice-president, Edward Fitzgerald; secretary, E. B. Fisher; treasurer, William J. Stuart.

TOPEKA, KAN.—The Mitchell & Williams Telephone Company, which has for a number of years been doing business as a private corporation at Silver Lake, has been granted a state charter by the charter board, and will henceforth be known as the Shawnee Independent Telephone Company. The capital stock is $15,000. W. P. Hemphill, one of the officers of the Topeka Independent company, is a director in the new concern, and it will be on the Independent long-distance service. The directors are Charles D. Williams, Silver Lake; W. P. Hemphill, Topeka; Edward Mitchell, Valencia; Ira C. Williams, North Topeka; M. E. Williams, Silver Lake.

PARIS, ILL.—A consolidation of all the trunk lines surrounding Paris has been consummated, the organization to be known as the Citizens' Mutual Telephone Company. The lines included are: Vermillion, Flemington, Nevins, Brocton, Libertyville, Dana, Marshall, Grandview, Redmon, Chrisman, Newport, Sanford, Clinton and Scott Land. The new company will construct a complete circuit around Paris, and while it does not enter Paris it will have first-class service with Terre Haute. An effort will be made to enter Paris over the lines of the Wabash Valley Telephone Company. If this should fail a proposition will be submitted to the city council asking for a franchise, on conditions acceptable to the city.

ELECTRIC RAILWAYS.

SALT LAKE CITY, UTAH—The Salt Lake & Ogden Railroad has increased its capital stock from $800,000 to $1,500,000, and will build an electric road through to Ogden cañon.

BAY CITY, MICH.—The county road commissioners have passed the amended ordinance for the proposed new electric line, from Bay City to Midland, St. Louis, and St. Johns.

SHENANDOAH, PA.—The borough council of Frackville has unanimously granted the Tamaqua & Pottsville Electric Railway Company a franchise through that borough.

MT. STERLING, KY.—The Blue Grass Traction Company, which runs an electric line to Paris from Lexington, will shortly begin the building of a twenty-five-mile electric road from Paris to Mt. Sterling.

HARTFORD CITY, IND.—The Grant county commissioners have granted a franchise to the Indianapolis, Hartford City & Celina Traction Company, which is constructing a line from Hartford City to Alexandria.

SANTA ROSA, CAL.—The Petaluma & Santa Rosa Electric Railway has determined to extend its line from Forestville, the present terminus of the Green Valley branch, to Trenton. This is only a short distance but will tap a rich section.

McKEESPORT, PA.—The lines of the Pittsburg & Westmoreland Railway Company have been completed to the city limits of McKeesport, and officials of the company say an entrance into the city will soon be secured and cars operated by November 1.

ABERDEEN, S. D.—S. H. Jumper, William Wallace, A. C. Witte, J. L. W. Zietlow, C. F. Easton, F. J. McArthur and C. N. Hereid have incorporated the Aberdeen Street Railway Company, which is organized for the purpose of establishing street railways in Aberdeen.

CUMBERLAND, MD.—The Cumberland council has been asked to grant a franchise to the South Cumberland Electric Railway Company, incorporated with $30,000 capital, to build a line from Baltimore and Mechanic streets to the Wabash station in South Cumberland.

PHILADELPHIA, PA.—The Lehigh Valley Transit Company has placed the order for machinery for its new power-house with the General Electric Company, and an order for ten closed winter cars and ten semi-convertible cars. Boiler and motor contracts are also to be placed.

DAVIS, I. T.—E. P. Spears, of Dallas, Tex., has closed a contract with the Lovejoy Construction Company, of Fort Worth, to grade ten miles for an electric line from Sulphur to Davis. The line from Oklahoma City to Sulphur will be eighty-four miles long and will cost $3,000,000.

ST. CATHARINES, ONT.—The project to build a trolley line through Welland County from Fort Erie to Crystal Beach or Point Albino, Ont., has been revived, according to a report current in railroad circles in Buffalo. It is said the promoters of the road have $1,000,000 in backing.

POTTSTOWN, PA.—The Pottstown council has unanimously adopted a resolution declaring null and void the franchise granted the Pottstown & Reading Electric Railway Company to occupy certain streets. This action was taken because the company failed to file a bond for $10,000.

DAYTON, OHIO—The Dayton Savings and Trust Company has been made the trustee in a mortgage for $800,000 which has been filed at Wabash, Ind., for the purpose of financing and finishing the section of the Indiana General Traction Company's line between Wabash and Warsaw, Ind.

MILWAUKEE, WIS.—Edward H. Vivian, who has been hiring men for construction work for the Chicago & Milwaukee Electric Railway Company, says there will be interurban connection between the two cities by November 1. An extension is now complete from Waukegan to Zion City, and the intervening gap to Kenosha is being rapidly filled in.

SAN DIEGO, CAL.—The Bay Shore & Pacific Railroad Company has been incorporated. Its object is to construct a railway along the shore of San Diego bay to Old Town, Pacific Beach and La Jolla, with branches on Point Loma, a total of thirty miles. The incorporators are H. C. Richards, C. R. Hammond, W. M. Crouse, Stephen Connell, I. D. Stewart and H. C. Oatman, of San Diego, and M. H. Rogers, of Denver.

KALAMAZOO, MICH.—A new traction company, the West Michigan Railway, has filed articles of incorporation and will succeed the West Michigan Traction Company in the project of building eighty-five miles of trolley line from Benton Harbor to Kalamazoo, with branch lines. B. L. Brown, an eastern capitalist, bought the property and right of way of the old, and organized the new concern.

FREDERICK, MD.—It is officially announced that the Frederick & Middletown electric railroad had been sold to the Baltimore & Frederick electric railroad and the new company will assume management of the road October 2. The deal, it is said, means the construction of a trolley line to Baltimore, which, with the Frederick & Middletown, will give a line from Hagerstown to Baltimore.

HELENA, MONT.—Formal transfer of the Helena Light and Traction Company's plant to Messrs. J. G. White & Company, of New York, has been made. With the advent of the new company it is expected that the five-cent fare will be inaugurated, together with other improvements. The principal change that marked the transfer was the retirement of Thomas A. Harlow, president of the old company, who is succeeded in control of the new interests by Howard A. Reynolds.

CLEVELAND, OHIO—A franchise for a new trolley line to Berea *via* South Brooklyn has been granted by the county commissioners to C. H. Hubbell, who represents the unknown backers of the project. The franchise is from South Brooklyn to the Berea limits and expires in twenty-five years. A cash deposit of $5,000 is required and this is to be forfeited if the road is not completed by December 31, 1906, provided the construction is not delayed by legal or other difficulties.

INDIANAPOLIS, IND.—The Chicago Electric Company, which is now in the hands of a receiver, is to be taken out of litigation and then be absorbed by the new Indiana corporation known as the Chicago & Southern Traction Company, which is capitalized at $2,000,000. The Indianapolis, Lafayette & Western, which is also a new corporation, is to be absorbed by this company and will construct a road from Kankakee to Lafayette, where connection will be made with the Indianapolis & Northwestern.

BELLAIRE, OHIO—At the first meeting of the stockholders of the Belmont Electric Street Railways Company, the following directors were elected: George W. Yost, T. A. Rodefer, Alex Neff, James F. Anderson, George O. Robinson, Franklin Neff, Henry Blum, A. Klotz, D. T. Cowen, Frank J. Mellott, R. L. Bowman, C. D. Lamb, John DuBois, C. Rumbach, W. G. McClain. The board organized by electing James F. Anderson president; George W. Yost, vice-president; D. W. Cooper, secretary-treasurer.

PHILADELPHIA, PA.—The work of constructing the foundations for the new power-house of the Philadelphia Rapid Transit Company has been begun. The plans call for concrete piling, concrete footings, and structural steel framework. The permit for the building itself was obtained in June last. The plans provided for a building of an average height of three stories, with a frontage of 102.8 feet and a depth of 200 feet, estimated to cost $300,000. The power-house will be one of the largest in the world.

PITTSBURG, PA.—Two new interurban lines have been projected into Pittsburg. The Canonsburg council has been asked for a franchise by the Carnegie, Oakdale & McDonald Street Railway Company, to pass through that borough. It will connect with the Pittsburg Railways Company at Mount Lebanon, and extend to Bridgeville, Cecil, Bishop and Canonsburg. A branch line from Cecil to McDonald, Noblestown and Oakdale is contemplated, and surveys for a line from Canonsburg to Washington are being made.

CANTON, OHIO—Plans have been made to build an electric line from Youngstown to East Liverpool, a distance of fifty miles. Most of the country is rough, and the construction will be costly. It is anticipated that the work will require at least $1,500,000. When completed the line will connect at East Liverpool with traction lines leading into Wheeling and Steubenville, and will also, by reaching Salem, connect with the Stark Electric and Northern Ohio Traction lines, thus forming a chain across the eastern section of Ohio.

PERSONAL MENTION.

MR. P. G. ROGERS, for the past eight or nine years with the Southwestern Telephone and Telegraph Company, and for the past year manager in charge of the Texarkana (Tex.) office, has resigned.

MR. J. B. COWEN, for a number of years connected with the General Incandescent Arc Light Company, has been appointed sales manager for the General Storage Battery Company, New York city.

MR. R. F. HAYWARD, chief electrical engineer of the Utah Railway, Light and Power Company for the past eleven years, has assumed the management of the Mexican Light and Power Company, Mexico City.

MR. WILLIAM F. RABER, superintendent of the Mansfield (Ohio) Railway, Light and Power Company, has resigned and will go to Enid, Okla., to take the management of a gas and electric light plant for the H. M. Byllesby Company.

MR. W. G. KNITTLE, formerly connected with the local telegraph office at Houston, Tex., and associated with the Big Four system since 1897, with headquarters in Dallas, Tex., has been appointed central passenger agent of this system, with headquarters in Cincinnati.

MR. F. A. HARRINGTON, of Albany, N. Y., superintendent of the Mohawk division of the New York Central Railroad, and a well-known railroad man, has been elected to the control of the Schenectady Railway, as president of the Schenectady Railway Company, to succeed Hinsdill Parsons, who resigned a short time ago.

MR. THOMAS D. HOXSEY, Brooklyn, N. Y., has been appointed secretary to the state lighting commission, at a salary of $3,000. Mr. Hoxsey is a capable young man, and is well known in newspaper circles, having represented the Brooklyn *Times* as legislative correspondent for many years. Mr. Hoxsey's headquarters will be in New York city.

MR. J. F. WITMER, Buffalo, N. Y., will assume charge of special work for J. G. White & Company bearing on hydraulic engineering in foreign fields. Mr. Witmer is a specialist of many years' standing, with offices at Buffalo, N. Y., and during the last ten years has designed and superintended the construction of waterworks systems in some thirty different towns and cities in the United States.

MR. B. B. WINCHESTER, of the Philadelphia Rapid Transit Company, is to succeed Mr. Frank A. Polhemus as superintendent of the New York & Long Island Traction Company. Mr. Polhemus returns to the West and will rejoin the corps of the Cleveland Construction Company, now building several trolley roads in the West. Mr. Winchester's headquarters will be at Hempstead, L. I.

DR. ALLAN V. GARRATT, chief engineer of the Lombard Governor Company, Ashland, Mass., was a New York visitor last week and met a number of his old-time friends in this city. Dr. Garratt was formerly secretary of the National Electric Light Association and also devoted some time to journalistic work in the electrical field, but of late has had charge of the engineering and sales departments of the Lombard company, in which field he has met with conspicuous success.

MR. JAMES C. HAIN has resigned as engineer of masonry construction for the Chicago, Milwaukee & St. Paul Railroad, and is now associated with J. G. White & Company, New York, as superintendent of masonry construction. Mr. Hain graduated in 1893 from the University of Wisconsin with the degree of B.S. in C.E. The university conferred upon him the degree of C.E. in June, 1905. Mr. Hain was with the Chicago, Milwaukee & St. Paul Railroad for ten years, and in that time gained a broad experience in the work which is supervised by its bridge and building department. While with this company he also had experience in general design and in detail computation and drawing. He also performed outside duties of surveying, collecting data and other work relative to replacing wooden bridges and other temporary structures with permanent masonry construction. During the year 1900-1901 he was in charge of the construction of the large ore dock and approaches at Escanaba, Mich. In 1901 Mr. Hain was appointed engineer of masonry construction, and in that capacity supervised all work of this nature that has been done during the last four years by the Chicago, Milwaukee & St. Paul Railroad on its 7,000-mile system.

MR. EUGENE HOLCOMB has been appointed recently manager of the newly created foreign department of the Allis-Chalmers Company. Mr. Holcomb takes charge of all the foreign agencies and foreign selling representatives of the company. He will supervise the work of the established European and South African offices, and all eastern hemisphere agencies, and will also have direct control over the South and Central American business of the company. Mr. Holcomb is thoroughly familiar with the engineering possibilities and projects in South America, having spent a number of years in that country. He has had immediate charge during the past three years of the Westinghouse company's interests in Argentina, with headquarters in Buenos Aires. Mr. Holcomb has had a broad engineering and financing experience in this field, and is a valuable acquisition to the Allis-Chalmers personnel. His headquarters will be at the general offices of the company at Milwaukee, Wis.

MR. EUGENE HOLCOMB.

MR. WALTER H. WHITESIDE has been elected president of the Allis-Chalmers Company. This is an indication that there will be no change in the policy of the company, as Mr. Whiteside has been during the absence in Europe since last April of his predecessor in office, in full charge of the operations of the organization, with the title of vice-president and general manager. Mr. Whiteside joined the Allis-Chalmers interests in July, 1904, when he accepted the position of general manager of sales. He came at a time when the company had just taken over the Bullock Electric Manufacturing Company and was ready for the introduction of a vigorous and energetic personality into its sales office. There was considerable work for Mr. Whiteside to undertake, the magnitude of which would have baffled an ordinary man. That Mr. Whiteside's efforts have been highly successful is indicated by the increase in the volume of the company's business, the busy session at the factories and shops, and the reopening of the old south foundry at Milwaukee. In taking up this higher and more responsible position, Mr. Whiteside has behind him not only the confidence of his organization, but a long and varied business experience, in which he has filled many executive positions. His achievements have won him recognition as a man of marked administrative ability. Mr. Whiteside is a member of the American Institute of Electrical Engineers; of the Engineers' and Lawyers' clubs, of New York; of the Mid-Day Club, Chicago, and of the Milwaukee Club.

MR. WALTER H. WHITESIDE.

MR. H. F. J. PORTER has opened an office in the Metropolitan Building, 1 Madison avenue, New York city, where he is prepared to give advice on general manufacturing and mechanical engineering questions tending toward industrial betterment, and to install "welfare work," which is now recognized as an important adjunct in enterprising manufacturing plants. The tendency on the part of employers generally is to improve the condition of their employés physically, morally and mentally. Properly directed efforts result in raising the efficiency of the organizations, with a consequent increased interest on capital invested. Mr. Porter has had a very valuable experience in this line of work, and the results of his

efforts in many large corporations have been uniformly successful. Mr. Porter is the oldest son of General Fitz John Porter. He was born in New York city in 1858, and educated at St. Paul School and Lehigh University. Mr. Porter spent some time with the New Jersey Steel and Iron Company, and also with the Cary & Moen Steel and Wire Works. In 1893 he was assistant mechanical engineer and assistant chief of the machinery department of the World's Columbian Exposition. In 1894 he was western manager of the Bethlehem Iron Company, and introduced the use of hollow shafts for large engines. He aided also very largely in the introduction of nickel steel. In 1897 he was transferred to the works at South Bethlehem, and was instrumental in introducing many improvements in the organization and management. In 1902 Mr. Porter was engaged by Mr. George Westinghouse to reorganize some of his interests at Pittsburg, and he is now engaged in introducing modern industrial methods into manufacturing enterprises. Mr. Porter is one of the original members of the American Society of Mechanical Engineers, the American Society of Testing Materials, and is also a member of the American Institute of Social Service, the Institute of Political and Social Science, the Franklin Institute, and the Engineers' Club.

ELECTRIC LIGHTING.

PHILADELPHIA, PA.—The Philadelphia Electric Company is prepared to begin the construction of a $250,000 office building.

BALTIMORE, MD.—The electric plant at Ocean City, Md., has been acquired by a Baltimore syndicate, composed of John W. Woodland, E. S. Johnson and W. D. Allen.

LINCOLN, NEB.—The city of Lincoln is now lighted in part by the new municipal electric system, erected at a cost of about $65,000 and operated in connection with the city water plant. This plant is expected to furnish between three and four hundred arc lamps.

TOLEDO, OHIO—The merger of the Toledo Gas Light and Coke Company, the Toledo Heating and Lighting Company, and the Citizens' Lighting and Heating Company, has been completed, and the merger company, the Toledo Gas, Electric and Heating Company, will enter the field.

FREDERICK, MD.—The Brunswick extension of the Harper's Ferry Electric Light and Power Company has been organized at Brunswick with the election of the following board of directors: Dr. H. S. Hedges, J. T. Martin, C. R. Gregory, Wm. Schnauffer, G. T. Hagan, H. M. Jones, F. E. Alder and Z. T. Brantner. The electric light will come from Harper's Ferry, the line having been run from that point to Brunswick.

COLUMBUS, OHIO—An investigating committee composed of two citizens—Messrs. George T. Spahr and A. W. Field—and three councilmen—M. A. Williams, G. A. Borden and Fred M. Sayre—has reported that if the municipal electric lighting plant at Columbus, Ohio, is rightly and carefully managed, it can be made to pay the city a good return on the money and effort expended. Under the present cost of operation the expense is sixty dollars per lamp per annum, as compared with the old contract at seventy-four dollars and fifty cents per year. The committee reports that the location of the plant is inconvenient for fuel supplies, and that the original cost of construction was very much higher than necessary. The committee reports that the plant is in very good condition for operation, and recommends that a complete system of accounting be installed. Mr. William Wilcox is superintendent of the city electric light plant.

ELECTRICAL SECURITIES.

During the past week there has been apparent a steady growth in confidence in the stock market. While a week ago the feeling was bearish, with uncertainty as to the predominating influence, the conditions at the closing of the market were decidedly bullish, and with fears of further disturbance largely dispelled. The continued favorable financial and industrial outlook, and the continued evidences of agricultural prosperity, make possible predictions of a very prosperous fall and winter. It is pretty definitely announced that this year the production of cereals promises to be small everywhere except on this continent. This is especially true of Russia, with the preliminary report for this year showing a total crop of 41,600,000 bushels, against 620,000,000 bushels last year. This will make for the building up of very large credits abroad, and will be of great importance in the question of foreign exchange rates and gold movements later in the year. Railroad activity and earnings continue to indicate a season of prosperity, and the iron and steel business is considerably ahead of estimates for this time of the year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 16.

New York:	*Closing.*
Brooklyn Rapid Transit	69¼
Consolidated Gas	182
General Electric	181½
Interborough Rapid Transit	215¾
Kings County Electric	200
Manhattan Elevated	163
Metropolitan Street Railway	127¾
New York & New Jersey Telephone	169
Westinghouse Manufacturing Company	180

A dividend of $2 per share will be paid on October 16 to stockholders of the General Electric Company of record at the close of business hours on September 20. The transfer books will not be closed.

Directors of the Interborough Rapid Transit Company have declared a dividend of 2 per cent, being the same amount paid last quarter. It is payable October 2 to holders of voting trust certificates as of record September 19.

The board of directors of the Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent upon the capital stock of the company, payable at the office of the treasurer on and after October 16 to shareholders of record at the close of the transfer books on September 20. For the purpose of the annual meeting of the stockholders, to be held October 11, and of the dividend, the transfer books will be closed from September 20 to October 13. The company has issued its quarterly statement for the three months ending September 30 (partly estimated), as follows: net revenue, $1,900,000; bond interest, $331,300, leaving a balance of $1,568,700; dividends, $1,217,021, making the surplus $351,679, which, added to the previous surplus of $15,974,209, gives a total of $16,325,888, as compared with $15,434,863 for the corresponding quarter of 1904.

Boston:	*Closing.*
American Telephone and Telegraph	139¾
Edison Electric Illuminating	250
Massachusetts Electric	59
New England Telephone	134
Western Telephone and Telegraph preferred	97

The statement of the Edison Electric Illuminating Company for the year ended June 30, 1905, is as follows: income from sales of light and power, etc., $3,340,921; expenses, taxes, etc., $2,177,974, leaving a net income of $1,162,947, other income, $5,105, a total of $1,168,052; interest and dividends, $1,152,718, leaving a surplus of $15,334, as compared with $11,543 for 1904, and a deficit of $20,320 for 1903.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	84
Electric Storage Battery preferred	84
Philadelphia Electric	9⅛
Philadelphia Rapid Transit	28⅛
United Gas Improvement	98½

The directors of the United Gas Improvement Company have declared a quarterly dividend of 2 per cent ($1 per share), payable October 14 to stockholders of record at the close of business September 30.

Chicago:	*Closing.*
Chicago Telephone	138
Chicago Edison Light	156
Metropolitan Elevated preferred	69
National Carbon common	60½
National Carbon preferred	114
Union Traction common	7
Union Traction preferred	33

The Northwestern Elevated Railroad has issued its report for the year ended June 30. The income account is as follows: gross, $1,786,414; expenses, $616,628; net, $1,169,786; charges, taxes, etc., $952,627, leaving a surplus of $217,627, as compared with $203,254 for 1904. The earnings are equal to 4.34 per cent on the $5,000,000 preferred stock.

INDUSTRIAL ITEMS.

THE CROWE NAME-PLATE AND ENGRAVING COMPANY, Chicago, Ill., will be pleased to send its new catalogue in colors, showing a very extensive variety of metal name-plates and advertising signs.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, is mailing an elaborate folder calling attention to the qualities and features of Buckeye lamps. In addition there is a series of eight lamp limerics.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., in bulletin No. 7036 describes its series-enclosed alternating arc-lighting system. Complete data, regarding the physical and theoretical characteristics of this apparatus, are given, together with diagrams of connections.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, will be pleased to send its new folder No. 4, descriptive of its No. Fourteen-Twenty type telephones. Views are given showing the exterior and interior of this telephone set.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is calling attention to its double-pole sockets. These sockets, the company states, leave no chance for grounding. They have copper contact shells, and are skilfully made from the best materials.

THE IDEAL ELECTRIC AND MANUFACTURING COMPANY, Mansfield, Ohio, issues an interesting series of bulletins covering the "Ideal" dynamos and motors of various sizes, as well as special elevator motors, elevator controllers, switchboards and panels, arc lamps and incandescent lamps.

THE NEW YORK EDISON COMPANY, 55 Duane street, New York city, in its September bulletin publishes a number of illustrations in color, showing the application of the Edison system of public service supply. Several striking illustrations are given, showing the adaptability of electric illumination.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, Yonkers, N. Y., has published two new price lists dealing, respectively, with "Habirshaw" white-core National Code wires and cables, and "Habirshaw" red-core wire. Mr. James B. Olson is the manager of sales, at 13-15 Cortlandt street, New York city.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., has opened an office in New York city at 39 Cortlandt street. Mr. Robert J. Mulligan will represent the company, and will carry a line of samples. Prices and any other information regarding Peru goods may be secured at this office. The telephone number is 298 Cortlandt.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has issued three bulletins, Nos. 1067, 1068 and 1070, descriptive, respectively, of type A transformers, type M induction motors and the company's series alternating-current arc-lighting system. These bulletins are worthy of immediate perusal, and will be sent to applicants.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing a bulletin (No. 72) descriptive of its "Two in One" transformers. These transformers are so designed and constructed that they operate interchangeably on either lighting or power circuits. Full descriptive and illustrative data are given in this bulletin. Other recent publications of the Wagner company are entitled "Recent Developments in Single-Phase, Alternating-Current Motors," by G. Percy Cole, and bulletin No. 73, describing a combined voltmeter and frequency indicator.

THE AITON MACHINE COMPANY, 126 Liberty street, New York city, will be pleased to send bulletin No. 62, describing one type of its No. 18 drum stranding machines. This is strongly and compactly built, and has a speed of approximately seventy-five revolutions per minute. The cradles for carrying the spools are made of high-grade steel, and are carried in babbitted boxes, so that all wear on the spider frames is eliminated. These machines are built in various other sizes and for different speeds.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Peoria, Ill.; Newark, Ohio; Cadiz, Ky.; Bartonsville, Ky.; Donnybrook, N. D.; Sherman, Tex.; Litchfield, Mich.; Georgetown, Tex.; Paoli, Kan.; Simpsonville, Ky.; Finchville, Ky.; Waddy, Ky.; Toledo, Ohio; Branchport, N. Y.; Scranton, Pa.; Lewiston, Ida.; Alpena, Mich.; Bristol, Tenn.; Des Moines, Iowa; Rochester, N. Y.; Walhalla, S. D.; Appalachacola, Fla.; Herman, Neb.

COPLEY-SENIOR CARBON COMPANY, 465 Greenwich street, New York, has recently been organized for the manufacture of the Copley-Senior carbon brush. This brush will be put on the market as a new type, and for which marked advantages are claimed, inasmuch as the manufacturers say that a degree of uniformity has been reached which heretofore has been unknown in this work, so that the unevenness often found in carbon brushes will be entirely eliminated. Mr. George W. Copley, whose name will be recognized by users of this product, is the president and general manager of the new company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has shipped to San Francisco a consignment stock of Gates rock and ore-breakers of various styles and sizes, together with standard repair parts, which may be required for Gates breakers which that company has already installed in various plants in California and neighboring states. By this arrangement any customer in this territory will be able to secure prompt delivery of repair parts for his machines. The venture will also enable the Allis-Chalmers Company to make immediate shipment of complete crushers required in that part of the country or in the islands of the Pacific. The San Francisco offices are located in the Rialto Building.

THE WHEELER REFLECTOR COMPANY, 156 Pearl street, Boston, Mass., is distributing its new general catalogue No. 26. A perusal of this volume will bring attention to several new specialties listed. Many of the regular styles are also worthy of attention. The company is making many styles of porcelain enameled steel reflectors, and is in a position to furnish anything special that may be required. The Wheeler No. 85 window reflectors are in very general use, and prompt deliveries can be made. The new adjustable bracket with these reflectors, the company states, merits especial attention. Only first-class enamel is used on the company's line of tin shades. In street fixtures the company calls attention to its very complete line. Mr. H. C. Hawks, general manager of the Wheeler Reflector Company, reports that during the past year the largest business in the history of the company has been done.

NEW MANUFACTURING COMPANIES.

CLAYTON, MO.—The Woolley Electric Company, of Clayton, organized to manufacture electrical supplies, has filed articles of incorporation for record. The capital stock is $25,000.

OSWEGO, N. Y.—The Electric Construction and Supply Company, of Oswego, has been incorporated with a capital of $25,000 and the following directors: F. G. Nicholson and E. R. Scott, of Syracuse, and John C. Knight, of Oswego.

DETROIT, MICH.—The Detroit Electrical Novelty Company, capitalized at $30,000, has been organized by Robert Wardle, Willis P. Rand, Henry Pickert, George Brown and John E. Moloney. The company will make specialties and electrically illuminated clock dials under assignment of patents taken out by Mr. Wardle.

MILWAUKEE, WIS.—The plant of the Milwaukee Electric Company is to be reopened in the near future. The name of the concern will now be the International Electric and Manufacturing Company, capitalized at $300,000. The stock of the new company is secured by a bond deposited with the Citizens' Trust Company. The plant is one of the finest at West Allis in the way of equipment and light, and when operated gives employment to nearly 1,000 men. The new company will manufacture and deal in electrical machinery of all kinds and descriptions, gas engines, steam boilers and engines. The plant has been idle for over a year.